Enhancing Resilience to Drought and Ecosystem Change in Drylands: Assessing Principles of Building Social-Ecological Resilience in Northern Ghana

Thesis

The Open University

Enhancing Resilience to Drought and Ecosystem Change in Drylands: Assessing Principles of Building Social-Ecological Resilience in Northern Ghana

Francis Kwame Appiah

Department of Geography

Faculty of Arts and Social Sciences

A Thesis Submitted in Fulfilment of the Requirements for the Degree of Doctor of Philosophy in Geography.

April 2020

DECLARATION

I confirm that this submitted thesis is wholly my own work, and that no part of my thesis has been accepted or is concurrently being submitted for any degree, diploma or certificate or other qualification in the Open University or elsewhere.

Candidate:	Francis Kwame Appiah
Lead Supervisor:	Professor Shonil Bhagwat
Co-Supervisor:	Professor Giles Mohan

Date: April 2020

ABSTRACT

The impacts of climate change are set to increase in the foreseeable future posing a great challenge for livelihoods in most rural areas in the developing countries. Drought is one of the main long-term stresses that impacts livelihoods dependent on agriculture and is set to increase in intensity and severity as a result of climate change. Building social-ecological resilience is therefore increasingly recognised as a necessary pathway to sustainable development within dryland communities. However, there are challenges with the sustainability of resilience interventions in communities where the need for poverty reduction and enhancement of livelihood systems is urgent. While the influence of ecological factors is widely documented, little is known about the role of deep-seated socio-cultural factors that can potentially mediate resilience building processes. To address this knowledge gap, this thesis explores the role of resilience building principles by way of literature review and an empirical case-study. The current evidence suggests there are key principles that should be considered when designing strategies to respond to climate change and build resilience in communities that are most impacted. This research therefore draws on 120 surveys, in-depth interviews and focus group discussions covering six villages of the Daffiama-Bussie-Issa district in the Upper West Region of Northern Ghana for the empirical study.

The findings of the study revealed the significant role that principles such as intent-driven trust, attachment to cultural identity and traditional values play in the processes of building community resilience to climate and environmental change. These principles, working together or individually, can significantly determine the successful adaptation of resilience strategies in communities and therefore should be understood and embraced. Trust for example was shown to mediate acceptance and therefore can ensure the successful implementation and long-term engagement of strategies that are designed to improve and build resilience in the face of deleterious climate change impacts. Additionally, addressing community and family cultural identity attachments was identified as a significant consideration to ensure that people are not alienated from their cultural alignment, which has the potential of leading to the rejection of viable resilience strategies. Finally, adherence to traditional values and practices was highlighted in the research to influence how people respond to, and conduct their daily living activities. Consequently, resilience building strategies should be designed in a way to incorporate significant traditional values. The major conclusion of the study is that individuals and communities may not necessarily accept and ensure the success of projects merely based on anticipated benefits to them. But, rather, they may consider what they determine to be

socially and culturally acceptable principles they can work with and are accustomed to. The implication of this is that resilience building policies and strategies should be designed with context-specific socio-cultural principles at the core, and from the outset, in order to secure community buy-ins required for effective and successful implementation of climate adaptation projects.

DEDICATION

Dedicated to my late parents, Chief Inspector of Police John Kingsford Appiah and Madam Juliana Amba Afful.

ACKNOWLEDGEMENTS

Firstly, I give all the thanks and praises to God Almighty for all He has done for me. I appreciate Him especially for the strength and wisdom to complete this PhD programme amidst difficult challenges, whilst protecting and sustaining me.

I am most grateful to my supervisors, Professors Shonil Bhagwat and Giles Mohan for their persistence, dedication and support throughout the programme which has ensured the successful completion of this thesis. Your thorough and constructive feedback helped to refine the ideas I have developed in this thesis. God bless you. My sincere appreciation also goes to the Open University's FASS for fully sponsoring my fieldwork data collection exercises to Ghana. God richly bless you all.

I am also thankful to the Ghana Government through the Ghana Education Trust Fund (GETFund) for sponsoring both my MSc course at Oxford University and this PhD. I am highly grateful and indebted to Professor Emmanuel Owusu-Marfo, who was instrumental in securing this GETFund scholarship. God bless you greatly sir.

Special mention and sincere thanks also go to Dr. Joyce Klu, Dr. Festus Asaaga Dr. Emmanuel Debrah, Dr. Emmanuel Otoo, Dr. Grace Pam, Dr. Justice Tankebe, Dr. Alexander Eduful, Mr. Godfred Amankwa, Mr. Stephen Donald-Cofie and Mr. Schneider Kumi-Larbi for their care and support during my studies in Oxford University and the Open University. You are a valued community. My fieldwork thanks go to Dr. Gideon Agbley who hosted me during the entire period of my data collection. Thank you very much for your generosity and the stimulating discussions that helped to shape my thoughts and guided the focus of some of the research questions for the thesis. A big shout of thanks to my research team at Wa in the Upper West Region of Ghana, led by Mr. Yakubu. God bless you all for your tireless efforts.

A special thanks goes to Dr. Irene Akosua Larbi for her contributions and insightful thoughts throughout this PhD. I also appreciate my church family at City of Faith Ministries, Aylesbury branch, especially, Pastor Evans Oppong, Pastor Nathaniel Komoah and Pastor Mrs. Lynette Komoah, as well as Pastor Ajiri Oletu. Thank you all for your prayer support.

I appreciate my great Appiah family for their unflinching love and support throughout my life's journey. God bless you all. Finally, to my wife Mrs. Vida Appiah, you are an 'angel'. Also, to our two daughters, Benedicta Appiah-Buabeng and Dorothy Appiah-Buabeng, thanks for bearing up many things so I could complete this PhD.

Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

AC	Adaptive Capacity
CAS	Complex Adaptive System
CES	Cultural Ecosystem Services
CS	Cultural Services
DBI	Daffiama-Bussie-Issa
DCE	District Chief Executive
DDP	Drylands Development Paradigm
ES	Ecosystem Services
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussion
HH	Household head
IPCC	Intergovernmental Panel on Climate Change
LEK	Local Environmental Knowledge
MEA	Millennium Ecosystem Assessment
MP	Member of Parliament
NTFPs	Non-Timber Forest Products
NWFPs	Non-Wood Forest Products
PES	Provisioning Ecosystem Services
RQ	Research Questions
SER	Social-ecological resilience
SES	Social-ecological systems
SLO	Social Licence to Operate
TEK	Traditional Ecological Knowledge
UNCCD	United Nations Convention for Combat Desertification
UNEP	United Nations Environmental Programme

Chapter one

General introduction

1.1 Chapter overview and background to the study

This thesis is set on the backdrop of the increasing effect of climate change which continue to worsen the living conditions of many local communities, limiting their ability to cope and survive, and the increasing need to strengthen the resilience of rural households and communities to be sustainable. This study adopts and applies social-ecological resilience (SER), which refers to the capacity of systems as households and communities to respond and deal with perturbations and be able to bounce-back without affecting basic functioning (Walker and Salt, 2006; 2012). SER is used interchangeably with just resilience throughout the thesis.

Adger et al. (2005) defines resilience as the capacity of social-ecological systems (SES) to absorb recurrent disturbances so as to retain essential structures, processes and feedbacks. Invariably, it is within the capacity of the system that the characteristics and abilities to respond and to recover from change develops, which has been referred to as the system's adaptive capacity (AC), the ability of a system to prepare in advance for perturbations, or adjust to respond to the effects of changes (Engle, 2011; Folke et al., 2010). The adaptive capacity is also suggested to be similar to resilience to a large extent (Biggs et al., 2015; Folke et al., 2010). Engle (2011:650) even stressed that "the more adaptive capacity within a system, the greater the likelihood that it will be more resilient".

However, the concept resilience though discussed extensively in the literature, is yet to have a single clear definition that can enhance its uptake and implementation in order to improve the capacity of society to respond to the impacts of climate change in particular. This situation also makes the assessment of the factors that can undermine or enhance the building of resilience somewhat challenging if not impossible in some circumstances (Aldunce et al., 2016). The concept resilience has widely influenced various fields of research and gained traction in policy areas (Aldunce et al., 2016). Some scholars have highlighted the need for conceptual clarity in order to improve upon and speed up empirical assessment of the concept to understand of key attributes that enhances or undermines it (Abson et al., 2013). Others have found it challenging and complex translating policies about the resilience concept and have called for the concept

to be defined in ways that resonate with real world conditions (Angelstam et al., 2013). There have arisen discussions around the broad diversity of perspectives surrounding the conceptualisation of resilience directed at addressing the ambiguities in order to forestall the potential of confusion among decision-makers and practitioners (Aldunce et al., 2016).

Yet, to balance the need for local households and communities to build their resilience to climate change, there is the urgent need to first, address the challenge of defining resilience so that people can understand what it entails in order to be able to develop and adopt appropriate resilience strategies. Second, build sufficient knowledge and understanding of underlying principles that can influence resilience processes thereby determining the kind and level of resilience that could be achieved. Consequently, the focus of this thesis is to explore the relationship between the adaptive capacity and resilience of a system, and to understand principles that can strengthen and build the resilience of ecosystems. It is based on the premise that by determining the role of the adaptive capacity, we can infer the resilience of the system. That is, as adaptive capacity increases, so is the resilience of the system expected to increase, and vice versa. The outcome of the research will help to understand which key principles underlie processes and responses to change, and to highlight how people and institutions prioritise such principles.

Decisions of how to respond to environmental change are generally informed by values. People bring different sets of values to the understanding of environmental issues depending on their varied backgrounds and contexts. Depending on where one is operating from the developed or developing world, and whether they are applying an expert or lay person's judgement, and are affecting locally or from a distant, all influence the decisions and responses people adopt in environmental issues. Understanding the foundations and principles of these values can enhance the building of social-ecological resilience. To this end, this thesis adopts an empirical case-study approach via a household and community perspective to investigates how smallholder farmers and households in rural Ghana 'respond' to critical social and environmental changes, addressing the key underlying social-ecological principles and factors, which largely are informed by values, and how these contribute to the processes of building resilience. The ultimate aim is to assess household and community responses and outcomes, that will help uncover what social-ecological principles underlie responses to change. The remainder of this chapter describes the research problem, the research objectives and questions the study seeks to address, the significance of the study, and the general outline of the entire thesis.

The field sites for the research consisted of 6 villages in the Daffiama-Bussie-Issa District of the Upper West Region of Ghana (see Figure 4.1). This region is a semi-arid tropical savannah with an annual rainfall of about 973mm on the Koppen-Geiger climate classification. Consequently, the soil is very poor, land degradation is pervasive, and the main income generating source, agriculture, is based on small-scale rainfed farming system. These constraints reduce productivity and erode the capacity of smallholder farmers to cope with change, which generally makes the region increasingly vulnerable. Faced with uncertain and increasing extreme environmental events in such dryland regions, there is the need to ameliorate land degradation and to build social-ecological resilience to enhance the capacity of communities to cope with change.

Investigating phenomena and examining change is a complex exercise that draws on interdisciplinary strengths (Hanson and Heeks, 2020). However, social research generally involves listening and observing social phenomena and applying theory to interpret or explain what is happening, why it is happening and how. This thesis employs an interplay of a mixture of methods of data collection, interpretation and analyses to explore the impacts of recurrent environmental changes, how the people cope and respond, focusing on the principles and factors that underly the building of social-ecological resilience in places like that. The subsequent sections in chapter one captures the research problem and justification, the main research questions and objectives, the structure and organization of the thesis and its significance in contemporary resilience studies and applications.

1.2 Research problem and justification

The abstract nature of the resilience concept continues to be a barrier to practitioners and scholars alike. This situation generally makes it difficult to operationalize and measure resilience of dynamic and complex systems such as social-ecological systems. Furthermore, the present condition is exacerbated by the seeming lack of clarity on how resilience is linked and similar to adaptive capacity in many respects (Biggs et al., 2015; Engle, 2011). However, framing the measurement and determination of a system's resilience via its adaptive capacity can help reduce the conceptual messiness involving the application of the resilience approach thereby making it difficult in translating the resilience theory into practice. Resilience of a system refers to the capacity of the system (SES - the integrated systems of humans and nature in a complex adaptive system where both the ecological and social components interact through multiple feedback networks) to maintain itself in the face of disturbances without losing its basic functions, by buffering shock and by adapting or transforming in response to change.

Adaptive capacity on the other hand generally represents the ability of a system to adjust or modify its characteristics to respond to internal or external disturbances, and to take advantage of opportunities and or cope with the effects of their impacts.

Furthermore, individuals or household or community resilience refers to the sum of all the activities (internal and external) that can be undertaken at those levels of society to strengthen and or to self-organise their adaptive capacity and resilience against any disturbances. Consequently, until we understand the clear linkages between the two concepts and the dynamics of underlying principles, as well as disentangling the practical contribution of adaptive capacity in building resilience, we may not learn the most effective ways of building resilience in complex adaptive systems such as drylands. What is social-ecological resilience? What principles are identified to build resilience? How has these been framed? What other considerations need to be addressed in order to improve social-ecological resilience? Addressing these questions is likely to increase and deepen our understanding on how and what builds resilience, focusing on the underlying sociocultural principles that can enhance social-ecological resilience in drylands for this thesis.

Resilience refers to the capacity of the system to be able to cope and adapt to change whilst maintaining its normal function. But, the ability and potential of the system to receive and cope with change refers to its adaptive capacity. The properties and outcome (resilience) of the system therefore is attained by improving the adaptive capacity it possesses. Improvements in the adaptive capacity consequently could lead to improved resilience of the system against change (Engle, 2011;2010). This study therefore highlights the significant contribution of adaptive capacity to the debate on clarifying the conceptual and practical complexity in the application of the resilience theory, which continuous to gain interest in most areas of research. Highlighting the adaptive capacity as one of the ways to practically explain and effectively implement and receive support for resilience projects. Below are some of the reasons this thesis identifies, and urges need attention on the adaptive capacity:

First, the conceptual messiness surrounding the definition and application of the resilience approach has the potential of affecting theoretical progress and empirical assessment (Abson et al., 2013), as well as practical implementation of resilience strategies. Second, translating policies about resilience and resilience outcomes as a social process in real world social-ecological systems is a complex and difficult task (Angelstam et al., 2013) that needs a mediating related concept such as the adaptive capacity to bridge understanding to propel

positive outcomes. Third, due to the challenge of putting in clear terms what the resilience theory is, has somehow led to it becoming unappealing to some social scientists largely because it is complicated to determine what the concept is, and therefore be able to measure it effectively (Olsson et al., 2015).

However, evidence is awash in the literature on the varied meanings assigned to the resilience concept and its application in different contexts (Aldunce, et al., 2016). These evidences point to the complexity in working with the concept, especially when implementing in local communities and as resilience programmes are designed for the long-term, will require the maximum cooperation from the community and its people.

Subsequently, anecdotal information from this thesis through the interactions and the questionnaire processes shows a sense of difficulty by the people understanding fully the conceptual underpinnings of the resilience approach. This challenge that had the potential of watering down our findings was resolved by vigorously and clearly training the research assistants in order to be able to explain in clear terms what we meant y resilience in this project.

But there is a strong likelihood to overcome most of the challenges with the resilience approach mentioned above by clearly explaining and prioritising adaptive capacity of systems to improve practitioner and beneficiary understanding and appreciation of the concept, thereby enhancing practical applicability to build resilience in ecosystems. Nevertheless, it is acknowledged that the claim might appear trivial and unnecessary. But this thesis stresses that until there is a clear understanding of what the resilience concept entails, empirical application of the concept will remain problematic, especially in local contexts, despite its increased potential of bridging interdisciplinary environmental research.

1.3 Research questions, aims and objectives

1.3.1 Research aims

The overarching aim of this thesis was to assess individual and community responses to change, and to uncover what social-ecological principles underlie responses to environmental changes. It explores the dynamic processes of the social-ecological system of the Daffiama-Bussie-Issa (DBI) District of the Upper West region of Ghana (see Figure. 4.1), and how these processes have changed over time. To achieve this, the thesis examines responses adopted by local communities as a result of environmental change and the consequent underlying key principles. The thesis further explores how these principles help to build resilience by enhancing the adaptive capacity in anticipation of future changes. The thesis project was originally designed

to assess the general resilience of individuals and communities against recurrent and escalating events (disturbances) via the lens of the social-ecological system concept by applying event ecology as the analytical framework. However, social capital was later adopted as the main analytical concept after the preliminary organisation of the data collected did not yield itself to a consistent application of the event ecology framework. This situation resulted from the challenge of obtaining chronologically consistent description of both environmental and social events that have occurred and could be discussed within the scope of this thesis. Consequently, this thesis re-focused on the climate change adaptation strategies people adopted to cope and become resilient, instead of the initial desire to uncover the resilience principles via a deeper assessment of events. The resulting adoption of the social capital concept involves analysing the benefits of networks, collective action and other features a community possesses that can influence its development. Details of the social capital concept and how this thesis applied it are laid out in chapters four and six.

The findings of this thesis promote the streamlining and mainstreaming of ideas, innovations and strategies for improving conditions for sustainable livelihood of vulnerable dryland dwellers, through highlighting complex adaptive system thinking, capacity building, learning and innovations, increased participation, cooperation and networks. Consequently, it attempts to distil indigenous experiences and knowledge, and other actor-space interactions into viable strategies for building social-ecological resilience in dryland ecosystems.

1.3.2 Research objectives

In order to answer the research questions and address the aim of the study, the study focused on the following specific objectives to:

1. Identify and analyse key characteristics of the social-ecological system, such as the nature of the farming systems in the study area (addressed within chapter five).
2. Examine the dynamics of environmental changes and common responses adopted by people (this is addressed within chapters five and six).
3. Investigate how resilience is understood and operationalised in the daily activities of the local communities (addressed within chapters five and six).

1.3.3 Research Questions

The general question of this thesis is borne from the conceptual complexities surrounding the resilience theory and its application and practice. Specific questions relate to what key principles matter to dryland dwellers in building social-ecological resilience, and what specific

role adaptive capacity can play to ameliorate the tension between the conceptual conundrum and practical application of resilience?

Invariably, there is the need for conceptual clarity. The resilience concept is rife with ontological challenges (Olsson et al., 2015) making unification of various sub-concepts counterproductive, but methodological pluralism could be much beneficial. Put simply, resilience as a concept exemplifies abstract meanings and lacks real existence. Fostering clarity by removing vagueness whilst prioritising its related notion of system's adaptive capacity could declutter the blurring of meaning and the dilution of application. This could invigorate the analytical potential of resilience. Additionally, restating the concept with a focus on adaptive capacity especially in local community resilience programmes could perhaps resonate with the people and therefore receive their support needed to be successful in the long-term.

Consequently, this thesis addresses the overarching research question of whether there are embedded socially and ecologically relevant 'principles' that have been learned and used over the years by indigenous people as responses to rapidly changing conditions, and how these principles can support the building of social-ecological resilience in drylands.

Subsequently, the thesis attempts to answer three main research questions (RQ) via a case study as follows:

Firstly, the first research question (RQ1) within the bounds of the overarching question attempts to understand how households and communities respond to the impacts of environmental stresses? Within this, the study seeks to understand the following:

- How are the households responding to climatic variability in the study communities? (Addressed in chapter five).
- What are the factors influencing or affecting the adaptive capacity of households in the communities? (Addressed within chapters five, six and seven).
- To what extent are coping mechanisms effective in enhancing the adaptive capacity and building resilience of households? (Addressed within chapter five).

Secondly, research question two (RQ2) examines what key principles underlie peoples' responses to environmental changes, and why? (Addressed within chapters five, six and seven).

Thirdly, research question three (RQ3) then explores what evidence is there that these principles are ecologically relevant in building resilience, whilst remaining relevant to the local people? (Addressed within chapters five, six and seven).

1.4 Significance of the study

This research investigated how smallholder farmers and households 'respond' to critical environmental 'events'; the key social-ecological principles and factors that act together to influence these responses and their subsequent contribution to the processes of building resilience in the major livelihood activities. The basis for focusing on the stated objectives stems from the fact that socio-ecological systems tend to build their resilient through a number of processes including enhancing the adaptive capacity. Therefore, an in-depth understanding of these processes and the principles which drive in local communities would provide an insight into how to develop climate change strategies that can build resilience; and help in the strategic targeting of policy interventions to the benefit of society. Also, conducting an empirical assessment of smallholder farmers' response to critical events such as droughts, as it provides insights into the functioning of society's systems in building social-ecological systems. The outcome of these assessments is then evaluated in the light of prevailing literature.

One of the emerged surprises of the study so far is the fact that contrary to some opinion that seem to suggest that local communities may only care about using natural resources, the study communities have carried on centuries old ancestral customs and rules to be worthy stewards of nature as inherited from their 'fathers'. Everyone in the community is aware of; and expected to take utmost care for nature in order not to incur the wrath of the gods. Such practices one may expect would have died gradually as a result of modernity, but not so in this study as anecdotal evidence depicts. For example, it is an absolute given according to interview data that the position of the custodian of the land is not contested should it become vacant. The most senior male member of the family with sound mind automatically assumes the position without question. Subsequently, the main findings are intriguing in the sense that they point to the fact that choices and actions of people in local communities may be governed by principles which are subjective, unseen, but very crucial in their everyday practices which cannot be overlooked when developing strategies and policies for them. Such principles as found in the study: trust, cultural identity attachment and traditional values, though not new, have to be considered carefully before any programmes are drawn. Otherwise, programme leaders risk the success of their projects, especially with long-term resilience-focused processes.

This study attempts to contribute to addressing two areas of gap in the literature. First, it responds to calls to prioritise the building of social-ecological resilience of ecosystems via the adaptive capacity, which in the end influences the resilience of the system. This thesis contributes to, and try to fill gaps in the practical relevance of adaptive capacity to redress some

of the conceptual bottlenecks. This ultimately aim to provide further discussions of climate change impacts especially in dryland ecosystems by strengthening resilience of these social-ecological systems. However, there are challenges of what resilience actually means in different contexts and spheres of application (Aldunce et al., 2016; Olsson et al., 2015). Some have suggested the engineering type of resilience which however is seen as rigid, unworkable in the face of complex change (Hanson and Hicks, 2020). The researcher's experience in his PhD upgrade presentation where he was challenged by one of the assessors on the practical application of the resilience in development programmes brought this problem into sharp focus. The researcher remember responding that the concept has evolved over the years encapsulating responses to environmental change through developing adaptable mechanisms within social-ecological systems which are flexible and context-specific.

This episode created a sense of a rethink regarding how the researcher may have to present resilience as a concept to local community members in order to understand their approaches to climate change. But the resilience literature seems to have not resolved clarity in the meaning of resilience as a concept in great depth, thus the need for further empirical researches that shed more light on how we can present the concept to gain the needed support for its implementation. The practice and application of the resilience concept in building resilience of social-ecological systems requires a practical approach to define what resilience is and what it seeks to achieve for local communities.

A detailed reading of the literature reveals that there will not be need for a new concept or approach to deliver resilience related responses, but the related concept of the adaptive capacity of systems could be engineered in a manner by which we can achieve resilience through the improvement of the adaptive capacity (the capability of adapting to change). Consequently, it is possible to clarify some of the misconceptions surrounding the resilience approach by prioritising the building of social-ecological resilience of ecosystems via the adaptive capacity, which in the end influences the resilience of the system. There is however a burgeoning gap of highlighting the practical relevance of the adaptive capacity to redress some of the conceptual bottlenecks which this thesis attempts to contribute. The second area this thesis seeks to make a contribution relates to the principles of building resilience. Literature search however reveals the strong focus on ecological principles as against social principles. Few studies have touched on the role of social principles in building resilience (Engle, 2011). Hence, this thesis sets to explore relevant principles underlying climate adaptation responses by local households and communities in drylands.

Subsequently, this thesis investigates the relevant principles which underlie decisions and choices of households and communities as people respond to impacts of climate change. Such knowledge when understood and harnessed is likely to enhance and reinforce strategies developed to build social-ecological resilience. The findings of this thesis have found and discussed three main principles which have highlighted the need to pay attention to subtle underlying factors that drive decisions, actions and practices of households and communities. These principles: trust, cultural identity attachment and traditional values manifesting in the form traditional ecological knowledge (TEK), are discussed in the empirical chapters (chapters 5, 6 and 7) of this thesis.

1.5 Thesis structure and organisation

This thesis is divided into eight chapters. Chapter One contains the introduction to the project, presenting the main aim, objectives and the research questions which broadly investigate the sociocultural and trust related principles relevant to the building of social-ecological resilience. Chapter two presents the literature on the theoretical and conceptual underpinnings adopted in this thesis, converging around the concept of resilience, and understanding how it is reflected in the livelihood responses of dryland dwellers. The literature on the resilience of social-ecological systems as complex adaptive systems is presented, focusing on principles such as the management of connectivity and the maintaining of diversity as necessary for building resilience of systems. Also, the arguments surrounding the role of the adaptive capacity in building resilience is discussed and conceptualised to provide the theoretical basis for the subsequent analysis of emerging themes in the succeeding empirical chapters.

Chapter three builds on the review of the relevant literature focusing on the contextual dynamics of dryland ecosystems, especially in Africa and Northern Ghana where the study is conducted. The chapter further reviews the current conditions of these dryland regions and the impact of climate change on the livelihood systems of vulnerable dwellers. Additionally, the implications of the application of the resilience approach in analysing drylands is discussed and contextualised in this chapter.

Chapter four presents a detailed discussion of the methodological considerations and methods of data collection and analyses adopted in the study. It elaborates on the underlying philosophical foundations upon which the mixed methods approach is adopted for the study, justifying also the relevance of using the exploratory case-based approach in the research. This chapter presents the justifications for adopting the Upper West Region of Ghana, which shares

border with Burkina Faso to the north and the Cote D'Ivoire to the West, focusing on the dynamic interactions that occur across these borders and how they may impact the capacity of communities to respond to environmental change. The selection of the DBI District as the study area is justified as the most central location in the region with connection to most of the other districts in the Upper West Region. This creates opportunities to explore further whether these kinds of interconnections may enhance or otherwise, the conditions of the people to be more resilient to recurring environmental changes. There are interesting dynamics within the district that are worth investigating to ascertain their contributions in the livelihood processes of the people and the building of resilience. Consequently, the analysis of the influence of the Gbele Game Reserve (forest) in the east on the adjoining villages through the edge-effect concept and natural resource use, and how this has led to nearby villages engaging predominantly in farming as against faraway communities in the west part of study area is presented. The chapter also outlines the procedure for the fieldwork investigations and data collection processes, and reports on the methodological limitations and ethical considerations.

Chapters five presents an empirical analysis of the significance of non-timber forest products (NTFPs) as alternative resource base for local communities in continued changing patterns of the environment and its impacts on agriculture which is the mainstay of the people. The dwindling nature of these natural resources and calls for deliberate measures to expand their base is highlighted in this chapter. It focuses on the need to unpick the implications of religious and traditional practices in relation to NTFPs exploitation, in order to ensure acceptance and to forge long-term partnerships necessary for the success of resilience strategies.

Chapter six explores the role of the principle of trust as a significant resilience building element. The chapter highlights the fact that intent-driven trust is needed between actors in order for resilience strategies in dryland communities, such as planting of drought resistant trees and crops, to be successful throughout their lifecycle. It demonstrates the fact that land as a common property is held in trust for the ancestors, thus, any signs of land grabbing will be resisted and may force viable resilience strategies to stop without completing their lifecycle and producing the intended benefits to communities. Land as a common property from the ancestors and upon which resilience strategies are implemented, could become a barrier when external actions evoke signs of land grab and are resisted by beneficiary communities. A framework developed by Wong (2007) which highlighted the unseen aspects of social capital for which trust is associated, yields itself to unravelling the influence of the idea of intent-driven trust on evoking community acceptance. This unseen social capital according to Wong (2007) is affected by

three elements: agency, structure and institutions. The agency component of the framework details the meanings that are associated with people's social interactions. Whereas the institution part constitutes the rules that guide individual's choices and decisions. Exploring the aspect of rules in the framework unpicks the significant role played by traditions, customs and religious practices in the daily living activities of local communities, which the thesis presents in chapters six and seven. The third component of the unseen social capital framework is 'structure', which specifies the limits of people's interactions. It is represented in this thesis by way of the principle of cultural attachment examined in chapter five. The framework also contributes to address research questions two and three of the thesis. Overall, the details about Wong's (2007) framework and its ramifications for addressing the overarching aim of this thesis, as well as the research questions are detailed in chapters six and eight.

Chapter seven build on the preceding empirical analyses to understand how traditions and religious practices are intricately connected to normal daily living which need unpicking to enrich the implementation of climate change adaptation strategies. It discusses the case that resilience has more to do than just policies, and highlights that climate change adaptation strategies must be designed and implemented in culturally sensitive ways.

Chapter eight concludes the research by bringing all the discussions on the main findings together, drawing out the common threads, by way of key principles that links them to building social-ecological resilience in drylands, and summarising these in line with the key research questions. The chapter also highlights the significance of understanding behavioural, social relations and intent-directed trust aspects of resilience embedded within communities to improve the acceptability and long-term success of resilience strategies. It draws some conclusions, reflecting on the contributions of this thesis and recommendations on possible further research that could be undertaken to extend the significance of the entire thesis on utilising trust-based sociocultural resilience relationships to enhance the livelihood systems of dryland dwellers with intent of actors as an important element of trust building.

Chapter two

Literature review

2.1. Chapter overview

This chapter presents the theoretical as well as the conceptual framework for the study by discussing the overarching concept of resilience and the adaptive capacity of social-ecological systems through the review of literature. A sufficient understanding of these concepts and what principles are likely to improve the adaptive capacity and resilience of livelihood systems of households and communities against climate change is necessary in the face of expected exacerbation of impacts.

Societies are increasingly facing rapid change in the environment in which they exist and flourish. Drylands which support about 2 billion and covers 41 percent of the world's total land area is continually affected by rapid environmental changes, which are exacerbated recurring socio-economic crises and conflicts (UNCCD, 2017a). Drylands consisting of arid and semi-arid regions whose population generally obtain livelihood through subsistence agriculture, are characterised by high variability in rainfall, droughts, poor and shallow soils, high temperatures, pests and diseases, and chronic crop failures especially in recent years as a result of the debilitating impacts of climate change. These conditions continuously threaten and affect the lives of the vulnerable dwellers of drylands mainly in Sub-Saharan Africa. But, in SSA agriculture which largely depends on rainfall, supports about 80 percent of the population (UNCCD, 2017b). Consequently, building resilience in the African drylands in particular by enhancing the capacity of communities to prepare for, and mitigate the effects of shocks has increasingly become important. Responding to these changes is not only crucial in saving the livelihood of the millions depending and surviving on drylands, but also to combat climate change and achieve the targets of the Sustainable Development Goals (SDGs). Therefore, the concept of resilience, which relates to having the ability to cope with change and develop with it, has become a critical and useful lens through which to gain useful insights in the human and nature relationship as a complex and dynamic system (Hanson and Heeks, 2020; Biggs et al., 2015; Walker and Salt, 2012; Engle, 2011; Folke et al., 2010). The purpose of this study is to assess resilience via system's identity, which can depict and has the potential of revealing the factors that have contributed to its present state. As postulated in Cumming et al. (2005),

system's identity largely reveals the underlying structures that generate phenomena, and the ways of resolving the question of how resilient a system is, and what the essential factors can be. Thus, understanding how resilience works by studying the influence of the system's identity (key components and interrelations) and underlying principles on building social-ecological resilience provides a level of generalisation that can be used across cases.

This chapter proceeds with an overview of the discussion of resilience and the socio-cultural attributes of households and societies in responding to climate change impacts in drylands. It aims to investigate the characteristics of systems (households and communities) framed in a broader perspective of understanding the key principles that can build resilience via improving the adaptive capacity of the system. This can indicate status of resilience attributable to the outcome of the event, and as the focus of this thesis, trace the key socio-cultural principles and factors mediating the changes they experience. Accordingly, the results of a project conducted by Aldunce et al. (2016) investigating how resilience can be applied to the management of drought in Chile revealed the following as the key determinants of building resilience in similar environments: improving education and access to information, enhancing preparedness, promoting technology transfer, reinforcing organisational linkages and collaboration, decentralising governance, and encouraging citizen participation. Addressing the relative contributions of these factors can help to strengthen the resilience of drought-prone regions to climate change. However, the building of resilience is largely context-specific and therefore sensitive to prevailing socio-cultural, political, economic and physical conditions and the general settings of communities. As such, investigating the components embedded within everyday practices of people through their decisions and choices in order to understand the associated processes and how they may improve the adaptive capacity and therefore enhance the building of resilience underscores the main focus of this thesis.

Certain cultural attributes have been identified to possess the potential of bridging divergent views in elucidating how humans adapt to or alter landscapes and by extension, other facets of livelihood especially in the rural areas (Haider et al., 2019; UNCCD, 2017a). This assertion gives credence to the significance of cultural properties in influencing how people respond to change. Thus, this study explores the contribution of socio-cultural attributes of households and societies in responding to climate change impacts in drylands. The following section consequently presents a brief literature review on the resilience approach and the related concept of adaptive capacity, which together form the overarching concepts for this study. The

review also discusses the current efforts in building resilience especially in Africa's drylands and how this work can contribute to the discourse.

2. 2 Defining resilience

2.2.1 Resilience approach and social-ecological-system

The concept resilience is basically about cultivating the capacity to function and develop despite expected or surprising change (Folke, 2016). According to Walker et al. (2002), resilience is about the ability of a system to withstand shock whilst also being able to maintain its structure. Resilience addresses the fundamental error of environmental management of assuming that ecosystems respond to human interventions and change is linear, predictable and controllable (Folke et al., 2002). Rather, the concept reinforces the notions of persistence, adaptability and transformation of complex adaptive social-ecological systems as the foundational characteristics of the resilience thinking and approach (Folke, 2016). It is against this backdrop that society and its surrounding biophysical elements are not viewed as separate entities, but as a coupled and intertwined human-environment system. Thus, efforts are continuously being made to apply the resilience thinking to capture and understand ways that society can govern social-ecological dynamics for the sustainable development and well-being of people and planet (Folke, 2016).

For example, resilience is strong in situations where major changes and variability in the climate (such as drought) result in insignificant loss of crop yield (Simelton et al., 2009). It shows basically that certain properties either within the crops themselves or the environment in which they were grown mitigated the effects of the climate, adapting to change and producing despite the changes. Such properties whether in principles, processes or innate abilities must be understood and harnessed to help improve the resilience of systems in the face of change. Consequently, the amount of change from either endogenous or exogenous source (s) a system can undergo and remain within the same regime, maintain same functions, structures and feedbacks determines its resilience. Carpenter et al. (2001) further argue that the ability of the system to self-organise and the degree to which it is capable of learning and adapting, are necessary conditions of resilience. But, the term resilience has been defined variously to simply refer to the capacity of systems to respond and deal with perturbations, and be able to bounce-back without affecting basic functioning (Walker & Salt, 2006;2012; Bhagwat, et al., 2012), which is vital for its continuous development.

Sometimes the driving factors of these changes are gradual or sudden such as the case in climate impacts (IPCC, 2007). The nature of the change, its magnitude and frequency all play significant complex roles in affecting the adaptive capacity of the system during the disturbance. Loss of resilience generally leads to the subsequent loss of valuable services provided by the system, and for that matter, the long-term sustainability (Folke et al., 2002). The amount of change capable of shifting a system into a new state and the time it takes to return to equilibrium have led to the suggestion of two types of resilience mentioned in the literature: Ecological resilience presented as the amount of disturbance a system can absorb without shifting to another state (Bhagwat et al., 2012; Walker, 1995; Holling, 1996; Gunderson, 2000), and Engineering resilience which is about the time taken for the system to return to equilibrium after the disturbance (Bhagwat et al., 2012; O'Neill et al., 1986; Holling, 1996). But, the systems research approach seeks to understand the dynamic interactions and trade-offs between the whole spectrum of elements that constrain or improve the SES understudy.

Current focus of the resilience concept has however shifted considerably toward ecological resilience, which considers the ability of systems to be flexible and adaptable to changing conditions, as against engineering resilience which stresses on the ability to resist change. However, other categorisations of the resilience approach delineate general resilience which concerns the broad-spectrum form of resilience for building resilience of SESs to respond to the unknown (Folke, 2016; Polasky et al., 2011). Whereas specific resilience involves addressing the resilience of 'what' to 'what' and for 'whom', (Carpenter et al., 2001; Brown, 2014). The third form is deliberative transformation where the specific resilience of the old is broken down to build anew (Folke et al., 2010). This option has been adopted in recent years (Folke, 2016). In this study however, our main focus is to understand the processes of building the resilience of household and community as social-ecological systems to the impacts of climate change such that development strategies do not result in alienating beneficial societies from their socio-cultural foundations. To do this, the study focuses on general resilience, but draws on specific resilience to disentangle and elucidate on the underlying principles that make resilience strategies viable and successful in rural communities.

One major aim of applying the resilience theory to empirical case studies is to assess the current state of SES and to judge whether or not properties of interest are resilient in relation to a potential desirable future state (Bennett et al., 2005). This could involve identifying actions that alter system resilience and strategies that focus on enhancing or reducing particular

priorities as system changes occur (Cumming et al., 2005). Subsequently, underlying these actions that are likely to undermine or build resilience, socio-culturally related principles that we need to understand and apply in resilience strategies in order to apprise the importance and power of people's attachments to gain acceptance and participation in resilience pathways (Haider et al., 2019).

However, the abstract and multidimensional nature of the resilience concept makes it difficult to operationalise thereby affecting assessment in complex systems. Moreover, it is also not so obvious what leads to resilience in a system, or which variables to concentrate on in a given study. Consequently, the use of surrogates as proxies to help operationalise resilience and to have clarity in defining key variables for resilience assessment is encouraged in the literature (Bennett et al., 2005; Carpenter et al., 2005). Similarly, others have mentioned that the state of the system's identity (property of key components and relationships) can give indications of its resilience (Cumming et al., 2005). In their desire to highlight ways of overcoming challenges of measuring resilience, Cumming and colleagues (2005) have stressed the identification of the system *identity* and how this change through time and space, as a practical way of understanding how resilient a system is. They referred to a system's ability to maintain its identity as the measure of resilience. Consequently, their conceptualisation described identity into four domains: (1) components, (2) relationships, (3) ability to maintain themselves (continuity) through space and time, and (4) innovation which serves as contributing factors to understanding resilience of complex systems. The table below shows the four aspects of the identity of a system and their attributes as suggested by Cumming et al. (2005) in detail.

Table 2.1: System identity and their attributes: adapted from Cumming et al. (2005: 976-978).

Aspect of system identity	Attributes
Components	***Human actors:*** e.g., Institutions, companies, leaders, ethnic groups, etc. ***Ecosystem types****:* forests, coral reefs, grasslands, etc. ***Resources:*** *goods & materials*: wood, fruits, bushmeat, water, etc. ***Abiotic factors:*** Water, heat, rainfall, elevation, geomorphology, etc.

Relationships	Describes ways system components interact and or fit together: it is typically the causal arrows linking boxes in system diagrams, but relationships will be linking edges in graphical theory. Typical examples include nutrient cycles, food webs, trophic interactions, economic & ecological competitions, land tenure systems, interactions between human actors.
Continuity	Depicts the ability of the system to maintain itself as a cohesive entity over space and time. It suggests that systems incapable of continuity will frequently and easily change their identity in the face of disturbances. Continuity is enhanced crucially by system memory; elderly people, seedbanks, social & biological legacies, customs, taboos, laws, formal archives & libraries that becomes repositories of knowledge and of identity.
Innovation	Represents those subsets of the larger system capable of generating change or novelty in response to changes the system face. It is comprised of items like social and ecological diversity, migration, levels of education, ways new technologies are developed and or adopted.

Explaining Table 2.1 in more detail, Cumming et al.'s (2005) proposition of how resilient a system is, is based on the fact that specific components and relationships may change over time, but essential attributes that define its identity must be maintained. In other words, the system may breach a threshold level and shift into a new domain of attraction (Robinson & Berkes, 2010; Gunderson and Holling, 2002) with different sets of essential attributes, thereby given it a new identity. Assessment must therefore be focused on the threshold levels the essential attributes of the identity of the system can maintain in order to adapt and be resilient to change, whilst, determining the nature of the event or activities that produce change and how to build or enhance the ability of the system to innovate and maintain continuity for a resilient outcome.

Embedded in the concept resilience are two components: resistance and recovery. Resistance refers to the ability to resist change which is also dependent on the magnitude of disturbance that may result in the change, whereas recovery refers to the ability and speed with which the system returns to its original structure after a disturbance (Cote and Darling, 2010). Contrary to common belief that undisturbed pristine ecosystems for example, are better able to resist and buffer against the impacts of climate change more than human-impacted ones (Bellwood et al., 2004), Cote and Darling (2010) in their work on coral reefs found less evidence in support of less degraded ecosystems (pristine) being more resilient than degraded ones. They further assert that those management strategies that seek to reduce local stressors and remove degradation are essentially increasing the vulnerability of ecosystems. But, with general agreement in favour of strong links between resilience and sustainability (Walker and Salt, 2012; Wilkinson, 2012); the assessment of drivers and impacts of change and the way to enhance social-ecological resilience has become more imperative. Consequently, various questions and issues need to be addressed, especially via the social-ecological resilience approach, which focuses on how coupled social-ecological systems can be managed to respond to disturbances while maintaining capacity for adaptation, learning and transformation (Folke et al., 2010; Wilkinson, 2012). The capacity to adapt, learn or transform is generally linked to the systems adaptive capacity (Berman et al., 2012; Engle, 2011), and the state of the adaptive capacity at the time of disturbance is crucial in determining how the system responds to change.

Subsequently, it has been suggested by some schools of thought that critical insights from the application of the building of social-ecological resilience (SER) in precarious regions such as drylands can address the challenge of managing such complex ecosystems. By this approach, society is viewed as a coupled social-ecological system where both the social and biophysical components mutually co-exist together and interact in a dynamic and complex fashion. This therefore reinforces the benefit of considering the social and ecological components together. (Biggs et al., 2015; Gonzalez-Cruz et al., 2015; Walker and Salt, 2012, 2006; Walker et al., 2002). In some systems, the ecological and social system interactions are very strong and necessary, such as the pollination processes influencing Brazil-nut crop, an important economic commodity for the locals (Cumming et al., 2005). The ecological elements of any social-ecological system mainly comprise of the biotic aspects of communities whilst the social elements are related to social characteristics such as property rights and access to resources (Gonzalez-Cruz et al., 2015; Gunderson, 2000). One of the basic questions the SER approach seeks to understand is how social-ecological systems build resilience and the key principles

that are involved. The resilience approach therefore affords crucial understanding of how to build capacity to deal with and respond to unexpected and unpredictable change in social-ecological systems over time (Gunderson and Holling, 2002; Gonzalez-Cruz et al., 2015). However, there are underlying principles that have been identified to build the resilience of SES, which together enhance the capacity of such coupled systems to cope in the face of disturbances (Biggs et al., 2015; Gunderson and Holling, 2002). This capacity of SES to cope is generally referred to as the adaptive capacity, and is defined as the ability of a system to prepare in advance for perturbations, or adjust to respond to the effects of changes (Engle, 2011; Smit and Pilifosova, 2001). It suffices to say that improving adaptive capacity therefore increases a system's ability to manage and cope with varying impacts.

Given the diversity in the ecological and social attributes of social-ecological systems, it has been suggested that the 'one-size fits all' solutions may not hold great promise for resolving environmental problems, especially, due to their complex and dynamic nature (Engle, 2011). But, due to the significance of local context in resolving environmental challenges, empirical research provides necessary backgrounds. Current resilience definitions can lead to distorted or limited interpretations in empirical studies, where variables that will determine system resilience in the future have to be measured in the present (Cumming et al., 2005). To avoid such controversies and to offer a better understanding of system resilience, Cumming et al. (2005) further encourage the adoption of a resilience view, which emphasizes the ability of the system to maintain its identity, and clearly demonstrates how the resilience of complex systems can be measured by using surrogates. It is clear from the discussions above that the concept of identity is helpful in resolving which variables to include in the measurement of resilience of SES. What is not clear or seriously addressed in the literature is how to build or enhance resilience of such coupled systems, and especially, which key principles and factors underlie the processes of building resilience via the features of a system's identity. This situation can be addressed via the adaptive capacity of the system, which refers to the ability of the system to prepare in advance for change. While the system identity helps to situate and determines what counts in building resilience, the adaptive capacity on the other hand can take it further and provide the foundation of how it is achieved.

Therefore, understanding how elements operate to build adaptive capacity thereby enhancing social-ecological resilience is very crucial in a world that is constantly changing, and requiring sustainable ways of managing its resources. But, how society respond to periods of change (abrupt or gradual) and reorganises itself to continue to function without failing (Biggs et al.,

2015; Diamond, 2005) has been one of the most researched subjects recently, but the critical processes are still least understood especially within conventional resource management (Gunderson and Holling, 2002; Walker and Salt, 2006; 2012). Moreover, the crucial role of the adaptive capacity in building social-ecological resilience is generally missing, or at best downplayed in the literature. It will therefore not be far-fetched to suggest that the ability of system components and relationships to maintain themselves continuously through space and time could largely be achieved via the enhancement of the adaptive capacity of individual components and the whole system. Overall, its crucial to identify key properties in the system been investigated, assessing both their historical functioning, challenges, opportunities, as well as the present state of the system in order to understand pathways that can foster or limit the building of resilience. This section has looked at the system's identity comprising of its components, interrelationships, continuities and innovation as presented in Cumming et al.'s (2005) work above. The next section elucidates on the linkages between system identity and its adaptive capacity, to deepen understanding of how adaptive capacity can be improved via the key properties of the system's identity thereby building its resilience in the end.

2.2.2 Linkages between system's identity, resilience and adaptive capacity

The resilience concept can be seen as opposite to vulnerability. Pereira (2017) stresses that in order to be resilient in the face of challenges, it is critical to possess adaptive capacity to the pressures. Though resilience continues to gain more prominence in various epistemological circles, its definition and application has been constrained by the difficulty of characterising its context-specific nature. However, this context-specific attribute of resilience is inherent in the adaptive capacity of the system (Carpenter and Brock, 2008), and therefore can help to address the not so easily generalised elements of the system, that may end up jeopardising efforts in building social-ecological resilience. Practitioners have often interpreted resilience differently and simply as 'bounce back' to the original system, whereas the scholarly literature debates about resilience being always positive or may be sometimes negative (Engle, 2011). With this trajectory of resilience possessing the potential of being either positive or negative, as well as not just meaning a bounce back, could present an inhibition to appropriate responses to change. However, addressing the conceptual and theoretical underpinnings of adaptive capacity presents a fresh opportunity whereby the application of the resilience approach could be critically examined for new insights. Therefore, focusing attention mainly on what resilience means hints merely on descriptive conceptualization and scratching the surface, and sparks a lack of definitional clarity.

Consequently, this lack of clarity led Gallopin (2006) to allude that there is no generally acceptable meaning for the concept of resilience akin to its related concepts of vulnerability and adaptive capacity. But at the same time, adjustments in the inherent capabilities of SESs to changing external drivers and internal processes (representing the adaptive capacity and given operational clarity to resilience) are treated superficially and missing important lessons for societal development (Carpenter and Brock, 2008). Brand and Jax (2007:10) also point out that "conceptual clarity and practical relevance of resilience are in critical danger". Thus, one can infer that when adaptive capacity is missed or at best glossed over, the cloudiness of the practical meaning of resilience may continue to persist. However, a critical assessment and framing of adaptive capacity by examining principles that build resilience can help address the problem through emphasising the conceptual contributions adaptive capacity make to the description and application of the resilience approach (Carpenter and Brock, 2008).

Originating from adaptability and adaptation, the concept of adaptive capacity generally refers to the strategies, capabilities, potentials that a system possesses to respond and cope with perturbations. The present situation is such that the resilience literature is concentrated with what resilience means and its contributions towards a sustainable future, while the potential capacities of the adaptive capacity are fragmented rather than theoretically coherent (Engle, 2011). This contrasts with suggestions that the adaptive capacity is in fact similar to resilience to a large extent (Biggs et al., 2015; Folke et al., 2010). Consequently, the mechanisms and factors that improve adaptive capacity and its role in building social-ecological resilience have been down-played. Therefore, there is a burgeoning knowledge gap that has resulted from the lack of focus on the conceptualisation of the adaptive capacity and its gains mainly in the areas of operationalizing ideas and strategies to build resilience. What is even more crucial of resilience and adaptive capacity as related concepts is the challenge of definition and measurement in order to foster critical assessment of their contributions. This thesis thus contributes via an empirical assessment of the responses and strategies local communities adopt in building social-ecological resilience, focusing on the key principles.

Adaptive capacity in the context of climate change has been defined by the Intergovernmental Panel on Climate Change (IPCC, 2007:869) as "the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences." Adaptive capacity (also referred to as adaptability) as defined by Smit and Pilifosova (2001), is the ability of a system to prepare for disturbances that cause change in advance or adjust and respond to the effects caused by

the disturbances. The definition hereby suggests two issues about the assessment of the adaptive capacity of a system. First, one has to examine the initial adaptive capacity before the disturbance and then what happens after the event as the system adjusts and copes with the effects. As stresses and their impacts vary in occurrence, increasing or building the adaptive capacity of systems improves their ability to manage various impacts, and at the same time maintain flexibility for adjustment towards future occurrences. Generally, however, a system's adaptive capacity can influence the ultimate potential for implementing sustainable adaptation. Adaptive capacity as a critical system property helps to mobilise resources to respond to perceived or current stresses (Jones et al., 2010). Moreover, despite the immense role the adaptive capacity plays in enhancing the capacity of SESs to respond to perturbations, its conceptual foundations seem not to have been addressed sufficiently in the literature. Engle (2011) for instance identified adaptive capacity as a common thread between resilience and vulnerability and suggested the need for more empirical studies to improve its characterization and measurement. But, only few scientific works have attempted to highlight the central role of adaptive capacity in characterizing resilience. However, these investigations have not gone far enough to improve measurement and understanding of the dynamics of the adaptive capacity (Gallopin, 2006).

Though measuring adaptive capacity and resilience directly is currently difficult, it will be a lot easier to approach it from the basis of analysing the characteristics that contribute to the adaptive capacity of the system (Jones et al., 2010; Cumming et al., 2005; Bennett et al., 2005), which to a large extent enhance the resilience of the system. In this sort of analyses the qualitative strength of the characteristics that build the system's adaptive capacity invariably is inferred to strengthen the resilience of the system. When these underlying characteristics are identified and critically assessed, both positive impacts, which should enhance the system's adaptive capacity (Jones et al., 2010) and by extension its resilience and negative impacts, could be addressed in line with the ultimate goal of the investigation. Thus, it is important to better understand the underlying principles that determine the level of household and community resilience against climate change. Such understanding could direct attention to functions of specific features, relevant factors and characteristics of community and household systems that need to be focused on with the aim of improving system resiliency and addressing the challenges of the capacity of the people to be resilient in the face of recurring environmental degradation.

Jenssen and Osnas (2005) drawing lessons from the immune system to understand the adaptive capacity of social-ecological systems distinguished between two types of responses to disturbances. The first enables the system to absorb disturbance from an existing disturbance and continue to function overcoming the change, similar to Holling's (1996) suggestion of engineering resilience. The second type of response on the other hand enables a system to reconstruct itself after a fundamental change in a disturbance regime, which can be related to Gunderson and Holling's (2002) system transformation postulation and Gunderson's (2000) ecological resilience. Therefore, addressing socio-ecological resilience has to account for both capacities of the system to respond to change by absorbing shock but also developing through the change. The capacity to absorb initial disturbance allows the system to adjust and be able to launch its stored capacity (learned and accumulated over time) to adapt and if necessary, transform itself in response to new disturbances. The resilience theory has continued to evolve in nature and definition and is characterised in various disciplines differently. But a historical analysis of its trajectory suggests that the ecological foundations of the theory are still prominent.

As the foregoing discussion highlights, this section has explored the conceptual, as well as the practical linkages between the system's identity, adaptive capacity and resilience. It is seen that the system identity informs the state of the characteristics and functioning of systems, whilst the adaptive capacity influences implementation of measures to improve the resilience of systems. Against this backdrop, this thesis explores the linkages between the adaptive capacity and resilience via the assessment of the principles that help to build social-ecological resilience in drylands. In the next section, a historical perspective of the resilience approach is discussed by chronologically tracing the evolution of the concept of resilience and its relevance. Understanding the major developments regarding the resilience theory and related concepts is important to provide the context within which to compare the attributes of systems adaptive capacity and how these contribute in building resilience.

2.3 Historical developments of the resilience approach

2.3.1 Origin and constructions of the resilience theory and current perspectives

Earlier developments of ecological resilience began with the attempts to mathematically model dynamic ecosystems in the 1960s and '70s (Gunderson et al., 2010). Resilience theory has been developed by ecologists over the past three decades to describe surprising and nonlinear dynamics of complex adaptive systems (Walker and Salt, 2012, 2006; Gunderson and Holling,

2002). Resilience has been looked at in the way systems are able to leap back from disturbances (Pimm, 1991). Gunderson et al. (2010) believe that the resilience theory has experienced three theoretical advances since its inception in the ecological circles. The first is its expansion and definition, second regards the adaptive cycle postulation, in which the properties of resilience are modified through time by internal dynamics, and third is the postulation of 'panarchy' to demonstrate the notions of scale and ecosystem change.

However, Holling (1973) introduced the word resilience to describe three aspects of change that occur in ecosystems over time: persistence within a system; alternative and multiple states; and surprises and discontinuous nature of change. But before Holling (1973) introduced resilience in ecological literature, which focused on relationships within a system and its ability to absorb change, and also possesses multiple states, concentration was on single equilibrium (Gunderson et al., 2010). This multiple stable state idea redirected focus on behaviour which is far from equilibrium and with stable boundaries. High variability and surprises within systems were key attributes of the new resilience thinking. Consequently, resilience at the time was the measure of the size of the stability state (i.e., the amount of change a system can absorb before its properties shift into a new state controlled by different variables).

In the 1980s and 1990s saw an increase in the demonstration that ecosystems displayed alternative states or regimes, which meant that they could shift to different states if the underlying conditions change. For example, grass-dominated or shrub dominated systems results from the intervening conditions of fire, herbivores and drought cycles (Walker, 1981; Dublin et al, 1990). Interestingly, studies in different ecosystems trace the underlining conditions for regime shifts to only a small number of variables (Folke et al., 2004), which suggests that much attention must be put on these small variables in order to build resilience in ecosystems and undertake critical system analyses. Coupling interplay between nature and society has been examined over the years with a long history and legacies and drawing interdisciplinary contributions on local and global levels. One key concept that emerged out of these varied collaborations is the concept of social-ecological system. Using this concept, Berkes and Folke (1998) referred to it as an integrated viewpoint of humans in nature, and also related it to the emerging concept of resilience. Given the difficulty and the blurredness that associated with the intertwined nature of the important relationship between humans and nature, Berkes and Folke (1998:4) also admitted the arbitrary nature of any delineation between the social and ecological aspects of the concept, referring to such attempts as "artificial and arbitrary." Broadly, the social aspect in the concept refer to the human dimensions including

the economic, political, cultural and technological, whereas the ecological encapsulates the activities of the earth's biosphere. Within the biosphere the dynamic relationships between the earth system and humans and their actions coevolve, whilst the genetic and species diversity of the biosphere enables it to persist and adapt in changing conditions, becoming more resilient. Moreover, the social-ecological systems concept highlights that people, communities, economies societies, cultures are embedded parts of the biosphere, shaping it at all levels (Folke, 2016; Folke et al., 2016; Walker and Salt, 2012, 2006).

As current discussions around the concept of social-ecological systems and its interconnection with the resilience approach in implementing research and development strategies to addresses the impacts of climate change intensify, it is vital that deeper understanding of sociocultural principles and human actions that underlie resilience building interventions be developed. Against this backdrop, this thesis investigates the principles relevant to dryland dwellers in building social-ecological resilience in the face of rapidly changing, and recurrent environmental degradations. However, to achieve this aim, it is important to understand climate change and resilience, which is discussed in the next section.

2.3.2 Climate change and resilience

The impacts of climate change on the livelihoods of many communities, and specifically to agriculture in the developing world, is projected to result in low agriculture yield, adverse impact of food security, changes in precipitation patterns, etc, (Elbehri et al., 2011). Yet, understanding the importance of developing strategies that are locally sensitive and adaptable to local conditions has been recognized as the effective way forward to tackling climate change (IPCC, 2014; UNEP, 2011). Additionally, there have been calls for building local context-specific responses from stakeholder inputs (Lee et al., 2014).

But, coping with the adverse effects of climate variability is nothing new to the people living in especially vulnerable ecosystems such as drylands. Farmers in such regions have continuously managed and made adjustments in behaviour and management strategies in response to the changes in precipitation patterns, soil moisture conditions, growing conditions, etc. Farmers usually adjust to planting dates, crop varieties, water storage and usage, and other measure in response to short-term climate variability (Lee et al., 2014; Smith and Malik, 2012). However, the rich knowledge and principles the dwellers of marginal areas have learnt and applied over the years are not acknowledged when addressing the resilience of their social-ecological systems, as well as proffering strategies that are rich in local context knowledge and

experiences. Current resilience thinking must position to address these deficiencies in order to identify the key principles that have helped sustained the resilience of already affected systems and incorporate such into long-term strategies to save livelihoods of the dwellers in the face of relentless impacts of climate change (IPCC, 2014; Reynolds et al., 2007).

With the gloomy outlook of the global impact of climate change on agriculture in particular, where dry areas will be drier and wet areas wetter according to IPCC's 5th Assessment Report (2014), improving the resilience of social-ecological systems in especially vulnerable regions like drylands is expected. Ironically, vulnerable regions already are suffering climate adaptation deficit, which has reduced their ability to respond to current threats and to prepare for future climate variability (Milman and Arsano, 2014). Addressing the existing deficit and preparing vulnerable communities to respond to future impacts requires development and adaptation strategies that apply principles of building social-ecological resilience in those regions. But, as noted by Cumming et al. (2005) it is crucial to isolate the system of human-nature interaction of concern and deeply study it to understand the level of its resilience and how to improve it in response to present and future changes. The systems thinking approach and the resilience theory working together to achieve social-ecological resilience is relevant in this respect. As expressed earlier in the forgoing discussions, the history of the resilience theory has moved on from its earlier description of resistance, stability in SESs and single stable-state, to the current focus on dynamism in systems, the potential of systems to be adaptable in various conditions, and the presence of multiple stable-state possibilities, that can enable systems to transform into new states when previous ones become unworkable and undesirable (see Table 2.2).

Table 2.2: Historical ecological management focus versus current resilience approach

	Previous ecological management focus	**Current resilience thinking**	**References**
1.	Stability	Dynamism	Folke (2016)
2.	Resistance	Adaptability	Walker and Salt (2012)
3.	Single stable-state	Multiple stable-states	Gunderson and Holling, 2002

2.4. Systems thinking and resilience approach

One of the fundamental questions humanity is faced with which requires further scrutiny is how to bridge the gap between the 'independence' we have created, and ever extending, and the 'interdependence' we understand the world to be (Peter Senge's speech at Aalto Forum, 2014). The interdependence nature of the world according to the assertion above brings to the fore the need for one to put on a system thing cap and perspective when addressing the challenges facing the world. Every condition therefore must be seen as forming a 'part' or component of a 'whole' which are interconnected in nature, and therefore should be treated in respect to the contributions of all the parts concerned to the problem at hand. The statement "we live as a system in a world of systems" also makes a compelling case much more so in problems of environmental management, which is a complex system within a world of systems and a world as a system itself (O'Connor and McDermott, 1997: xiv).

A system can be defined as an entity which maintains its functions through the interactions between the parts. The 'parts' therefore determine and maintain the way the 'whole' operates. Consequently, knowledge is gained about the functioning of the system by analysing the individual parts. However, when a synthesis (building parts into whole) is done tracing and examining how the various parts connect, interact and feedback into each other, a deeper understanding is gained on the functioning of the system and how shocks (internal or external) could alter the dynamics of the system, and may transform it into a completely new state with new characteristics (O'Connor and McDermott, 1997; Gunderson and Holling, 2002).

In essence, the earth is a complex, interconnected, interdependent and continuously evolving entity that requires a systemic perspective of thinking and acting to understand it better, in order to achieve long-term sustainability which is the overarching aim of the resilience approach. System thinking addresses deeper patterns and connections that form the foundations of entities, whilst increasing understanding of existing interdependencies. The resultant holistic approach addresses many of the environmental and social issues confronting the world, with most of the contributing factors and actors assembled that enables scientists and other practitioners to trace with greater control the causal linkages and key characteristics of the system, enabling solutions that rightly answer to the interwoven nature of the issues. The resilience approach and system thinking perspective as much as they can lead to increased understanding of how structures and processes themselves affect, and are affected by change, and what appropriate responses society need to adopt, together also help to envision and build appropriate futures to mitigate the prevailing environmental changes.

2.4.1 Contributions of the systems perspective to the resilience approach

With many different variables and factors involved in addressing complex cases such as in social-ecological systems, the application of the system thinking perspective to resilience assessment will help simplify matters by involving the essentials, while disregarding the non-essential details (Bennett et al., 2005). In this way complex processes are broken down into simplified, but detailed structures that capture key details about the phenomenon understudy. Bennett et al. (2005) also affirm that system models help to organise essential elements into structures that highlight key connections and interactions between the components, thereby providing a framework of analysis which can be used to examine the factors and thresholds that determine resilience of a system. System structures are inherently complex with many parts and always part of a larger system, as system parts and sub-systems all interrelating and influencing each other in a dynamic fashion. Complexity could be complicated in appearance, but might have simple patterns underneath, which is known as apparent complexity. It could also be a dynamic complexity (great number of possible connections between parts) inherent complexity (multiple, simultaneous feedback loops with small changes able to make large differences) or detailed complexity (large number of parts).

One of the areas systems thinking contributes to the study of the resilience concept is in the area of delineating what boundaries are relevant and should be captured and assessed. This is essential because the parts of a system are bounded together by many links creating a unique structure, like in the case of social-ecological systems which consist of both social attributes and ecological components. Undoubtedly, the arrangement of the parts into structure is crucial, and whatever affects one part has a likely consequence on all the other parts, though might be in different proportions, and the resulting effect obviously alters the behaviour of the whole system. Boundary definition also brings to the fore the crucial issue of objectivity or subjectivity in the application of systems approach in investigations. It is always difficult for the investigator to be totally separated from the structure of the system, as well as the likely impact thereof. The question of where the investigator is positioned with respect to the system as defined by the boundaries of the study and whether he or she could deliver final total objectivity, is always under review, since there is no such thing as total objectivity (O'Connor and McDermott, 1997). In a nutshell, the boundary one sets must be useful to the goals of the study and must be described clearly at the outset. Everything else is connected and understudied within the confines of the system boundary limits, outside which different context and meaning exists. Defining the system boundary for the study must be critically considered from the initial

stages to capture the goals of the study, while setting out clearly one's philosophical as well as methodological orientation. Both subjective and objective perspectives can be applied in systems thinking, but it is vital to set out to which one the study is inclined and to take every precaution to incorporate one's impact on the final outcome and findings, since one cannot step out of a system of which he or she is part and investigate it from a neutral point of view. It should also be recognised that systems have got limits, which when breached could easily result in the failure or collapse of the system.

The use of system approach in resilience assessment enables most of the key elements to be identified and characterised as they work together. This enables slow-changing variables such as soil erosion to be uncovered and evaluated, including critical feedback processes which together are very relevant in determining the state of a system, and for that matter how resilient its key elements are in the face of disturbances. Invariably, the synergy property of a system which refers to the combined effects produced by the parts or elements of the system working together, plays a very significant role in many areas of life, but its relevance is not widely highlighted in research (Corning, 1995). Synergy can be considered as one of the core concepts of the system sciences, and it's always co-determined and interdependent. It fosters co-operation and determines a system's continuity, evolution and progress, and also directs the overall resultant effects of the system. When the system's synergy is functional and thriving, it enhances the progress and achievement of the desired system outcomes. Synergy underlies the causal linkages between system parts and for that matter directs system outcomes. It may be looked at as the linking cord that strengthens the harmony between parts.

System modelling helps experimentation into possible alternatives and scenario building in order to select the most effective alternative pathway to achieving higher resilience, which would not be practicable when other methods are used. Such experimentations can reveal patterns that drive events to be highlighted for detailed analysis and understanding in order to predict future events and prepare for them. It fosters effective ways of dealing with problems through devising better thinking strategies appropriately fashioned to match the nature of the problems. In systems approach we gain direction on how things are connected and on which areas to concentrate efforts to achieve maximum desirable impact. Mostly, it is the structure of the system that determines the outcome we derive from it. Therefore, gaining a deeper understanding of the structure underlying a particular system leads to gaining influence over it (O'Connor and McDermott, 1997). This also helps us to understand complexities within

processes and provides the best possible ways of improving those complexities to achieve long-term outcomes.

The system's behaviour depends on the total structure working together. Changing the structure will alter its behaviour, which can result from any of the parts. Though, changes to certain 'small' parts could produce large ripple effect in the whole system and may alter dramatically the behaviour and functioning of the system. The whole system's behaviour influences the behaviour of its parts, and the parts in turn determine how the entire system functions and characterized. Subsequently, system thinking sees beyond isolated and independent events into deeper patterns of connections between events, and in this way offering the best possible chance of forming appropriate conclusions. Significantly, since there are uncertainties surrounding many of our actions in the spheres of life and especially in environmental challenges and climate change, the systems perspective that addresses complexities by recognising interconnectivities whilst highlighting underlying processes, could provide the novelty needed to answer most of the current questions facing the natural world as a system. Consequently, resilience measurement could considerably benefit from applying system thinking perspective in more ways as described above.

2.5. Resilience assessment and measurement

System identity gives meaning and functions within its constituents, and therefore determines its level of resilience. Some systems may shift into entirely new ones, while others may maintain the same identity through experiencing growth and reorganization and therefore will be considered to be resilient (Cumming et al., 2005). Assessment and measurement of resilience is a difficult task, which hinges strongly on how the concept is defined. Thus, there are usually underlining differences between measurements as a result of the lack of a precise definition, whilst Windle (2011) states clearly that assessment is closely linked to the issue of definition of the concept and key associated conditions. One has to define and trace the main causes of change within the system in respect to a particular perturbation, but at the same time delimiting those changes not associated with the specific disturbance.

Walker and Salt (2006) have stated the following points regarding the measurement and application of the resilience thinking in addressing policy and management of natural resources.

- Ecosystems or social systems cannot be managed in isolation

- Adaptive cycles of systems must be accounted for to identify the stage the system is in, in order to know what kind of intervention to apply
- One needs to understand the present scale and the effects of the scales above and below.
- Must identify the key slow controlling variables that may have threshold effects.
- Identify any possible alternative regimes for the system, based on the slow controlling variables
- Identify the key points of intervention that can avoid undesirable alternative regimes.
- Recognize that simplifying the system for greater efficiency may reduce the system's resilience, making it more vulnerable to stress.
- Invest in adaptability, e.g., Social capital, leadership and networks and promote learning and experimentation.
- Be aware that there is a cost to maintaining resilience.

However, each of the points mentioned above by working individually on their own may not achieve the desired expected outcomes. There is therefore, the need to create the necessary platform where most of the ideas and key resilience principles can work in conjunction in order to develop long-term capabilities within the system properties to maintain and improve its identity, and by extension, its resilience over time.

2.5.1 Key principles of building social-ecological resilience and the role of adaptive capacity

Embedded within the resilience thinking, as well as the adaptive capacity conceptualisation are terms such as diversity, redundancy, resistance, flexibility, regenerate, self-maintaining/self-organising, and transformation. These terms play critical roles individually and in combination to maintain and or increase resilience in SESs. However, their primary function first improves the adaptive capacity, which invariably influences the resilience of the system. Systems also have to maintain some resistance to changes, especially impromptu ones, and at the same time, be flexible enough to accommodate and adapt to change. To maintain their fundamental function in the face of disturbance, systems in addition will have to be regenerative, self-organising and transformative where necessary. Each of the terms described above forms part of the adaptive capacity of systems. Achieving all the above with the ultimate goal of building resilience should be addressed via the assessment of the adaptive capacity of SES (Gonzalez-Cruz et al., 2015). Folke et al. (2002) for example have also highlighted that learning to live with change and uncertainty, nurturing diversity for resilience, combining different types of knowledge for learning and creating opportunity for self-organization towards social-

ecological sustainability, as critical factors interacting across temporal and spatial scales which are required in dealing with natural resource dynamics during periods of change and reorganization. But, research works such as by Biggs et al. (2015) have proposed seven principles relevant in building resilience in social-ecological systems: (1) maintain diversity and redundancy; (2) manage connectivity; (3) manage slow variables; (4) foster complex adaptive systems thinking; (5) encourage learning; (6) broaden participation; (7) promote polycentric governance. These are described briefly below and form the basis for the present work.

2.5.1.1 Understanding the seven principles of building resilience in ecosystems

Redundancy is the duplication of critical components or functions of a system with the intention of increasing reliability of the system, usually in the case of a backup or fail-safe. Overlapping functions and redundancy provide potential for adaptive capacity and reorganisation (Folke et al., 2002). Recognising and appropriating inherent ecosystems redundancies provide and enhance the capacity to be much less likely to be surprised by loss of ecological resilience (Gunderson and Holling, 2002). The concept of the "range of natural variability" expressed in Wong and Iverson (2004), highlights strongly how maintaining redundancy within systems enlarges their adaptive capacity. There are basically three types of redundancy relevant to ecosystem management, namely, functional, structural and institutional redundancy. Functional redundancy refers to the duplication of ecosystem functioning via species composition and variability. Structural redundancy on the other hand refers to the duplication of structure through spatial arrangement. Institutional redundancy involves the duplication of institutions such as, politics and governance arrangements relevant to maintaining ecosystem functioning and resilience (Walker, 1995). The golden rule according to Holling and Meffe (1996:334) is that "management should strive to retain critical types and ranges of natural variation in resource systems in order to maintain their resiliency". This means that diversity anchored within redundancy in systems should form the main foundation strengthening adaptive capacity, and for that matter increasing system resilience to perturbations. On the other hand, there is loss of resilience when system natural variation is reduced, defined by Holling and Meffe (1996) as the pathology of natural resource management. Subsequently, understanding human actions in managing and adapting to change via creating institutional redundancy to respond to change is significant. This will help deepen our knowledge in how to deal with conflicts and overlaps of authority likely to occur, which have the potential of stalling the effects of any resilience strategy, especially in communities

where authority channels are vested only in the chiefs or elders with the potential of shutting any other form of authority that could be tagged as dissenting.

Diversity is a related property of redundancy, and in combination, plays a crucial role in enhancing resilience of SESs in many ways. It provides system components the needed options to respond to, and deal with disturbances, uncertainties and surprises (Briggs, Schluter and Schoon, 2015; Walter and Salt, 2006). It is emphasised that systems that can cope in future challenges are those that exhibit or possess diversity (Pereira, 2017). Not surprising therefore, studies have highlighted the functional importance of diversity and that when systems possess more heterogeneous components, they tend to be more resilient than those with less different components (Cardinal et al. 2012). Diversity as a concept is used in different fields of study and attracts varying meanings. These varying definitions result from the different aspects of diversity under consideration or utilization (Odum, 1953). Importantly, developing redundancy within the diverse elements of the system, especially in what Briggs, Schluter and Schoon (2015) called 'response diversity', ensures the system continues to maintain its basic functioning as it responds to change and disturbance. However, investigation into how much of redundancy and diversity to allow and in what compositions is crucially important. There is the increase in cost implication (such as administrative, coordinating and transaction costs) of adding more elements that can perform similar functions to provide insurance and security in times of perturbations. But who meets the extra costs, on what basis and for which reasons, and to avoid potential power struggles, all of which must be considered critically from the outset. Consideration and attention must also be given to trade-offs between maintaining fewer elements that perform functions efficiently and the increase of diversity and redundancy for backup.

Another principle, connectivity between elements, species, materials, etc., of systems facilitates interaction, distribution and flow among its members and parts. By connectivity the system elements depend and support each other via the exchanging and transfer of resources thereby being better able to recover and become more resilient in the face of disturbance (Vasilis et al., 2015). However, in the same way that connectivity can enhance resilience by facilitating recovery through the sharing of resources and essential properties, it can also act against and stop the spread of disturbances (like the spread of wildfires and diseases). Connectivity can enhance resilience by providing connections between habitat refuges that can serve as sources of recovery after perturbations. By way of building or increasing resilience, connectivity could result in breaking of social isolation and increase resource access, while

precluding outside interests on the local landscape (Cumming et al, 2005). There must exist a mutually nuanced balance between improved local internal connectivity and external influence in order to achieve increased system resilience. But, understanding and mapping the connectivity between important elements and their interactions is vital in enhancing resilience of SES. Important interactions that are not functioning could be identified and restored, and this could lead to improved connectivity patterns needed for enhancing social-ecological resilience. Constant interactions among various actors for example can develop trust and reciprocity thereby enhancing governance opportunities within the system. Deeper understanding of the various connections, pathways and flows within the systems can help to design strategies to enhance those parts that can build resilience, whilst diminishing connections that can lead to propagation of undesired flows in order to improve the resilience of the system.

Social-ecological systems can, and do exist in different regimes, producing different set of products and consequences. Slow variables (that change more gradually relative to other fast variables) and their consequent feedbacks are crucial on how systems behave and respond to change. The processes of these variables and feedbacks can influence the shift of systems from one regime to another, and often cause rapid and large changes and impacts to societies (Biggs et al., 2015). Ecologically, soil composition as a slow variable for example has a huge impact on crop production, which is a 'fast' variable. Values, traditions, and thinking patterns, are some of the slow variables in society that influence the status and structure of systems. For instance, a kind of profession a community follows is largely informed by values, traditions and worldview prevailing in that particular society. Feedbacks are produced within SESs as variables operate when changes loop back to affect original variables. Identifying and managing these interactions, especially among slow variables which often produce large impacts, is vital in enhancing resilience.

Complex adaptive system (CAS) thinking as a resilience principle, recognises SESs as complex-dynamic entities characterized by non-linear processes, interconnectedness, heterogeneity, complex feedback loops, inherent uncertainties, etc, which makes them behave and produce different outcomes. CAS and for that matter SESs, have many different parts that interact, process and feedback at different scales and levels. These features make large parts of CAS uncertain, thereby presenting challenges to control, forecast and prediction (Bohensky et al., 2015). However, components are highly adaptive to change, and this helps them to self-organize, evolve and renew in the face of disturbance. Viewing and approaching SESs as CAS

enhances resilience in many ways. It develops holistic, rather than reductionist approaches in management and adopts integrated ways of managing trade-offs and feedbacks within multiple ecosystems (Bohensky et al., 2015).

Encourage learning as a principle of building resilience in SESs takes on board the inherent peculiarity of CAS, recognising that complexities and uncertainties form significant part of SESs. It therefore advocates and promotes continuous learning process via revising existing knowledge, re-evaluating values, creating new knowledge, and acquiring alternative understanding to processes within any action or management, to enhance resilience (Cundill et al., 2015). The adoption of a continuous learning approach can foster proactive management approaches that introduce variety and also allow the resolve and flexibility between alternate hypotheses and methods.

Governance has been discussed variously in the literature as a key factor which promotes inclusivity, participation and equality, thereby facilitating the building of resilience and sustainable development in economies (Sachs, 2015; Berman et al., 2012; Walker et al., 2002). At the heart of governance are strong institutions which foster and allow for broad participation in the governance process, including management and decision-making processes. Leitch et al (2015) describes participation as the active engagement of relevant stakeholders in the management and governance process. Participation could range from simple, to higher level power processes, occurring at various levels of management process (Stringer et al., 2006). The important role participation plays in building resilience among others include the fostering of legitimacy in the process, building of trust among stakeholders, facilitating transparency and sharing of knowledge and learning. All these characteristics cement the process right from the initial goal setting stage through to the implementation and the evaluation and re-appraisal stages. Deeper understanding of factors contributing to effective participation such as clarity of goals and expectations, involvement of the right people, facilitation and leadership, capacity building, effective power application, and resourcing (Leitch et al., 2015), are all critical. Trust can facilitate collective action, whilst strengthening the connectivity amongst groups and individuals, especially in local communities, fosters multiple perspectives and offers alternative pathways in the participating processes. Therefore, the key specific and varied intricate roles they play in building social-ecological resilience are worth investigating. However, the challenge of the possible emergence of conflicts amongst groups and households which carries the potential of impacting negatively the benefits of the collective action

processes warrant an investigation to increase our understanding in order to anticipate and prepare for such consequences.

Governance, referring to the processes of decision making and rules that govern a group of people or society, is suggested to play a key role in whether a system becomes more resilient or vulnerable (Adger and Vincent, 2005). A broader and far-reaching form of governance which continues to gain much traction in the resilience literature is polycentric governance (Biggs et al., 2015; Schoon, 2012; Ostrom, 1990). Polycentric governance is simply a governance system which entails the interaction of multiple governing entities with autonomy to make and enforce rules for the benefit of a group or policy sphere. Ostrom (2001) has described polycentricity to consist of multiple governing authorities that interact across different levels of the policy process. The interactions between the governing units occur in a nested fashion that provide and create enabling foundations for the operation of other resilience-enhancing factors. Polycentricity is about the importance of connecting local informal institutions and collective action among engaged citizens with formal institutions across different levels of society to work from the local to the global to achieve common goals. However, any strategy aimed at building resilience within SESs as CASs involves a complex decision making, and there are uncertainties to deal with, trade-offs and varied needs to be met and numerous variables to consider. Therefore, the processes and rules that lead to these decisions therefore have to be representative, collaborative, inclusive and flexible.

Governance at multiple smaller scale level benefits from polycentricism, which offers the opportunity of experimentation (at reduced risk) at more localized levels, creating natural experiments for trying different policies, essential for learning and flexibility. Polycentric governance systems in addition of being flexible are also apt for change, better able to cope with change and could expand over time to accommodate more complex changes. However, apart from polycentric governance helping to organise society to solve collective problems and achieve common goals, there are potential tensions among actors and rivals. This situation can lead to negative institutional interactions and affect the building of conducive foundations for learning and information sharing (Biggs et al., 2015). Consequently, regarding the processes of polycentric governance and resilience, there is the need to identify whether there are fragmentations, segmentations and complexities within existing governance structures and institutions, and how these impact on other components of the system and the building of social-ecological resilience in particular. Of critical interest for understanding is how communities have organised activities around governance institutions and policies (vertically

with higher actors and horizontally with actors on similar levels) in achieving social-ecological improvement.

The brief review of the seven principles of building resilience in ecosystems presented above has shown the contributions of individual principles and how they operate and can be applied. Furthermore, the principles are understood to be useful not just by themselves, but in combination with others, by understanding how, when and where they apply. Moreover, context matters in how these principles combine to enhance the resilience of ecosystems. Consequently, a context-specific investigation to uncover and understand the more hidden and under-acknowledged sociocultural principles that underlie people's actions and choices which also could inform what resilience strategies to adopt is required. Such investigations will require that both the ecological and social properties of systems are identified, and their complex interdependences delineated and studied for much in-depth insights. Hence, examples of the ecological and the social properties of slow variables as discussed above, and its fast variables counterpart are displayed in Figure 2.1.

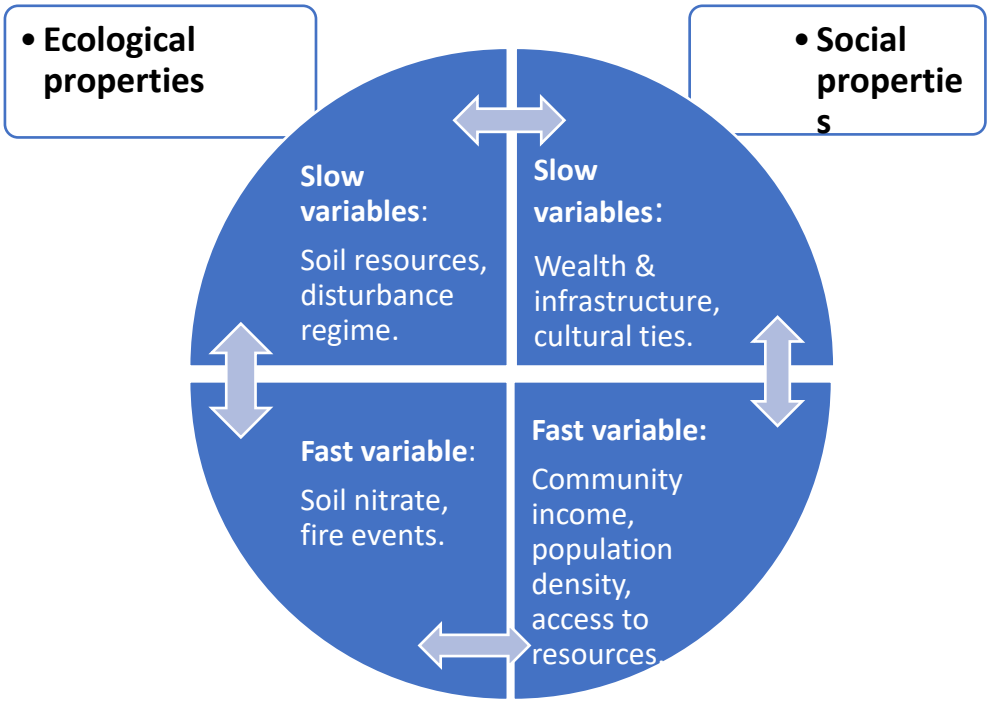


Figure 2.1: Characteristics of the ecological and social properties of SES modified from Chapin et al., 2009:7.

Figure 2:1 depicts a social-ecological system which is affected by ecological properties on the left and social properties on the right, where both do not exert separately, but influencing the

system together as well as a flow between them, with the resultant effect contributing to the state (which Cumming et al., 2005 referred to as identity) of the system. In the interplay of attributes of both the social and ecological properties within the system, slow variables in each side usually takes long to form and manifest, therefore not easily identified, but contribute to a great extent the resilience of the SES. Fast variables on the other hand, can easily accumulate and change more quickly than slow variables. Understanding the effects of both slow and fast variables as they influence environmental change, and what principles underlie their operations, is important.

2.5.2 How is the assessment of resilience in ecosystems done?

Generally, the use of data collection methods is to help capture meanings and activities associated with an issue of interest in the natural occurring setting as possible in order to minimize researcher bias on the data. As Jancowicz (2000) suggests, different issues require different approaches and methods in collecting and analysing data. Subsequently, the assessment of resilience of social-ecological systems require a varied portfolio of methods and instruments. These methods must answer questions of relevance, accuracy, adequacy, and the findings generated thereof should be able to be replicated and applied generally. However, the researcher may employ open-ended questions, key stakeholder in-depth interviews, focus group discussion (FGD), participant observation, household surveys, biophysical surveys, site visits, documentary sources, and other ethnographic research techniques to collect relevant field data for analysis (Gonzalez-Cruz et al., 2015; Nyantakyi-Frimpong and Bezner-Kerr, 2015; Snorek et al., 2014; Berg, 2009).

Social-ecological systems as complex and dynamic systems result from consequent complex interactions of large numbers of variables (Gordon and Enfors, 2008). But according to Gunderson and Holling (2002), the emphasis could be on three to five key variables that capture the behaviour and processes of such complex adaptive systems, which need to be identified and examined via a mix of the methods to collect and analyse data on how they sustain or enhance resilience (Gonzalez-Cruz et al. 2015). Carpenter et al. (2005) have also suggested four approaches to adopt in analysing resilience: stakeholder analysis through workshops, model explorations, historical profiling, and case study comparisons of systems that change in different ways. Additionally, the data gathered from the exercise could help identify and analyse the roles of key principles and factors that underlie household and community responses to change, whilst bringing more insights as to whether community activities and practices are a consequence of specific events.

2.5.2.1 System and Unit of analysis

Even though providing a precise definition of SES for assessment can be difficult (Gordon and Enfors, 2008), the general understanding is that it is made up of both the social and ecological sub-systems interacting in the same unit space of analysis. With both parts of the system impacting on each other and producing feedback that influence present outcomes. Therefore, a better understanding of the processes and underlying drivers can be achieved by analysing the social and ecological sub-systems together instead of as separate entities (Gunderson and Holling, 2002). The social characteristics that are of interest in this thesis could include the community/household/individuals, institutions (traditional and government), beliefs, practices, socioeconomic activities, upward level interactions with the district/regional/national units, as well as downward relationships with household/individual units. The ecological characteristics on the other hand could include agricultural/farming systems, farm sizes, type of crops, rainfall/drought pattern, soil pattern/degradation, etc, whilst data could be collected via observations, measurements, and documentary records. The size, boundary and components of the system, however, should clearly be determined and described from the outset in order to forestall any ambiguities that may influence the research outcomes negatively.

But, the unit of analysis delimits the main components of the SES understudy, focusing on the elements that exert relatively large influences on the functioning of the system. For example, despite the negative feedback and impacts of agriculture (such as habitat loss and degradation via extensive deforestation) on ecosystem functioning and health, it is still the main avenue through which governments and development partners continue to proffer solutions towards tackling chronic poverty in most developing countries particularly in Africa and Asia. Given that smallholder rural farmers manage over 80% of the world's estimated 500 million small farms (UNEP, 2013), farming in rural communities like most study areas in the developing world, remains a critical pathway toward achieving meaningful livelihood attainments. Consequently, the unit of analysis for most resilience-related studies in Africa and similar places focus on smallholder farmers and households as the main earners of income (and resources) and livelihood (Robinson and Berkes, 2010; Reynolds et al., 2007). Coupling their complex interactions with the environment of SESs for analyses on how the society cope and respond to events such as drought, whilst subsequently enhancing adaptive capacity and thereby building social-ecological resilience constitutes a significant point of analyses.

2.5.2.2 The concept of identity and resilience assessment

Resilience assessment usually must involve operationalising a specific and potential change of a system based on a prior notion of system identity before disturbance and a set of alternative desirable futures depicting the nature of resilience of the study system. One of the initial activities is to specify spatial and temporal boundaries of assessment and specify the system subsets which are of greater interest. In other words, for each of the essential attributes selected for investigation specific variables that are likely to alter in response to changes, in intensity or extent, must be of priority. However, variables are selected for investigation based on their relevance to the research questions to be addressed.

However, challenges of the application of the resilience theory, including defining the system, measuring the drivers of change and conditions under which system resilience will be assessed, need to be addressed beforehand. Moreover, one has to also account for his or her subjectivity that could influence the questions and goal of the research (Cumming et al., 2005). Cumming et al.'s (2005) expression of measuring resilience via its identity, comprising of the components, their relationships, continuity and innovations, is similar to the suggestions of using surrogates (Bennett et al., 2005; Carpenter et al., 2005). Overall, the various components and interconnections are shown to be important in understanding the processes of building resilience, however, a deeper insight of the underlying principles that guides these processes is necessary.

2.5.2.3 Using resilience surrogates for its assessment

The abstract nature of the concept resilience makes difficult, if not impossible to measure it directly. Measurement is made much more complex by the challenge of identifying and understanding the key attributes of the system that are directly responsible for its resilience. One way to address this challenge is by using surrogates as suggested by Bennett et al. (2005), which helps to situate the resilience assessment from a metaphor to measurement (Carpenter, et al.. 2001). Bennett et al. (2005) employed a set of system model templates to understand and determine resilience surrogates they defined as "proxies that are derived directly from theory for use in assessing resilience in a social-ecological system" (Bennett et al., 2005:946). They follow the steps of first defining the problem to investigate and address, then map out the various feedback loops that can be discovered, understand the system design and then finally determine what the resilience surrogates can be and need to be investigated. Subsequently, following the above steps can produce five key surrogates of resilience; the distance of the state variable from the specified threshold, the *rate* at which the state variable is moving towards or

away from the threshold, the influence of outside controls or shocks to the rate or direction of change of the state variable (all relating to the distance of the threshold), the location of the threshold and the rate of change of the threshold (both relating to movement of the threshold itself).

2.6 Summary and current knowledge gaps

2.6.1 Summary

This chapter which focused on the conceptual basis of the study has undertaken literature review of the relevant theoretical concepts as well as established the knowledge gaps in this area of research. It is evident from the foregoing reviewing of literature that the resilience theory has continued to increase in popularity and application in the development, ecological and environmental literatures since it was introduced in the 1970s. However, there have been difficulties regarding general application, which has led to the constant call of designing context-specific assessment and description of what resilience means. Additionally, to further understand the theory of resilience calls for empirical studies to apply and test it in order to substantiate the theoretical claims with practical field evidence.

This literature survey looked at what resilience means and represents, and its focal idea of nonlinearity and multiple stability states in systems. The resilience approach views both social and ecological aspects of the environment as coupled systems that can best be studied together rather than separate entities, thus as a social-ecological system. It is suggested in the literature that assessing resilience via surrogates and particularly using the framework of system identity, which Cumming et al. (2005) defined to consists of system components, relationships, continuity and innovation, is helpful and curtails the challenge of what precise measure of resilience is within a system. Consequently, the linkages between the system identity, adaptive capacity and resilience were reviewed so as to locate where focus must be placed in the process of building resilience. Subsequently, the historical development of the resilience theory was traced and how it is affected by climate change, especially in the communities of the developing world. Furthermore, the reviewed literature on how resilience assessment is conducted has highlighted what key issues guide the entire process. Thus, the case of dryland ecosystems and the critical need for building resilience was visited, which highlighted key underlying conditions impeding their progress, but at the same time could serve as opportunities for thinking new approaches that will help develop drylands.

2.6.2 Current gaps in the resilience literature

What is not clear or seriously addressed in the literature is how to build or enhance resilience of coupled social ecological systems in semi-arid regions, and especially, the understanding of the key principles and factors that underlay the processes of building resilience, via the conceptualization and assessment of the features of a system's identity (Cumming et al., 2005). Additionally, by placing emphasis on the concept of identity to aid assessment of resilience it makes it a little easier to grasp and operationalise and be able to determine how resilient a system is and what makes the system resilient.

There is also the lack of focused international science especially regarding dryland ecosystems, resulting in the relatively little exposure in the popular and scientific media on developments in drylands (Reynolds et al., 2007). Studies and strategies geared toward building resilience seem to overlook the rich knowledge and principles that dwellers of marginal areas have learnt and applied over the years, and for that matter do not largely tape into them when addressing the resilience of social-ecological systems. But these principles could be seen as critical factors underlying the building of resilience (Folke, 2016; Gunderson and Holling, 2002), especially in proffering strategies that are rich in local contexts and experiences.

Moreover, existing resilience studies have overlooked the significant role of 'adaptive capacity' as the missing link between operationalizing the resilience concept and development. Few studies have suggested that resilience and adaptive capacity are similar (Biggs et al, 2015; Engle, 2011), and few others have described it as an emerging property of resilience (Gunderson and Holling, 2002). But, in many occasions the idea of the system's 'capacity' to persist in the face of change (Folke, 2016) and develop as a function of its adaptive capacity is missed.

2.6.3 How does this thesis attempt to contribute to knowledge?

The research study is designed to characterize the concept of resilience in dryland ecosystems. It attempts to empirically progress the understanding of key principles which individuals and communities apply in responding to changes that affect their ability to adapt. In this way, this thesis helps to examine and test the contextual relevance of the principles of building resilience via an empirical research project to provide the necessary background to further understand and operationalise the resilience concept, especially in dryland ecosystems. Crucially, principles identified in the literature and specifically presented in Biggs et al.'s (2015) work could be empirically tested against local contexts and in different ecosystems.

Furthermore, this research seeks to contribute in the area of highlighting the role of adaptive capacity in bridging the resilience concept and sustainable development by emphasising that the ability to adapt and become resilient practically resides in, and is dependent on the status of the adaptive capacity. The thesis addresses linkages between resilience as a descriptive concept and as an approach or boundary object (Brand and Jax, 2007), as well as an 'organising concept' (Brown, 2014), and adaptive capacity as the system function to achieve resilience (Engle, 2011). Such insights will broaden the understanding of the interdependencies between the two concepts, and how to use the knowledge to further the resilience discourses and prioritise development strategies.

Similarly, the study is expected to build on the idea that the resilience approach is one of the lenses to ask questions in order to increase understanding of the complex and dynamic nature of social-ecological systems (Folke, 2016). Therefore, as the resilience thinking is useful in framing the project through the questions it focuses on to address, the resilience of the system on the other hand is enhanced through the adaptive capacity which ultimately determines the resilience of the SES.

Chapter three

Dryland ecosystems and resilience

3.1 Chapter overview

This chapter builds on chapter two by situating discussions of resilience in the context of dryland ecosystems. It is premised on the notion that the increase developments in drylands and desertification requires resilient interventions to help the livelihood activities, especially of communities and households. The chapter discusses the increased cases of desertification which are mainly attributed to climate changes and anthropogenic causes. It further highlights the case of drylands in the African context and the different characteristics that require appropriate resilience approaches.

3.2 An overview of dryland ecosystems

The UN Convention for Combating Desertification (UNCCD, 1994) classifies drylands as areas with annual precipitation to potential evapotranspiration ratio of between 0.05 and 0.65. Challenges experienced in dryland ecosystems include land degradation, drought, conflicts, famine, etc, conditions exacerbated by the effect of the climate change phenomenon. But, the Intergovernmental Panel on Climate Change (IPCC, 2007) has further predicted an increase in the impacts of climate change and extreme environmental change in dryland regions over the coming years. Furthermore, drylands are viewed as areas with large year-to-year variability in climate with accelerated and unprecedented periods of change. It has largely been demonstrated the planet's life support system continue to be undermined and moving towards a point where it is likely to be overwhelmed by a combination of forces of climate change, declining biodiversity, pollution, and social unrest (Lucatello et al., 2020; Feng and Fu, 2013). However, nowhere are these changes and challenges on the planet evident more than in drylands. The livelihoods of the billions of people depending on the ecosystem services provided by drylands are always under pressure, which also suggests that dryland dwellers are the first to be affected by widespread changes such as land degradation, climate change and undermined water cycle. Despite the myriad challenges associated with drylands, its dwellers continue to learn ways to cope, adapt and innovate to survive these harsh conditions, most times for long generations.

Therefore, it is very crucial to tap into this rich local knowledge store of the people through research towards an understanding of how to support the drylands better and to build resilience of their ecosystems to climate change.

Drylands are characterised by high ecological and cultural diversity. A third of the global hotspots in biodiversity is in drylands. They are culturally diverse and account for 24% of the world's languages (Safriel et al., 2005). Traditionally, many social groups moved both seasonally and in response to prolonged droughts (Davidson, 2006). The need to cope and adapt to harsh conditions and repeated episodes of scarcity has given rise to strong cultural traditions. Water availability strongly constrains both biological production and human development. Drylands receive only 8% of the world's fresh water supply, 30 % less per capita of the minimum required for human well-being (Safriel et al., 2005). Soils tend to be shallow and have low moisture retention capacity as a result of high rates of wind and water erosion in drylands. Thus, vegetation productivity is also very low which results in low organic matter and aggregate strength. These together makes dryland soils prone to erosion.

Furthermore, there are severe shortages of drinking water, much lower per capita GNP and high infant mortality. Dryland populations are among the most marginalised ecologically, socially and politically in the world. Given that 10-20% of drylands are desertified, their populations are usually seen as the most vulnerable to the increases in frequency of drought events as a result of climate change. Additionally, rapid population growth coupled with livelihoods at risk creates the potential of exacerbating the myriad effects of water shortages and land degradation that can force people to migrate to other parts of the world relatively better (Smith et al., 2009). Consequently, most of the social and ecological changes drylands have experienced recently have rendered them less social-ecologically resilient. Therefore, understanding what sources supported the origin resilience of drylands, and how these have changed and how can they be restored or generate new sources of resilience for drylands, are all key areas of study. However, it is also imperative that underlying principles that inform local actions and choices, such as respect for traditional values, are first understood in order to facilitate the implementation of the strategies for building resilience for sustainable dryland ecosystems.

The extensive degradation of drylands comprising arid, semi-arid, and dry sub-humid areas by various climatic and human activities is what the UNCCD (1994) has designated as desertification. However, despite the enormous challenging conditions in drylands to the well-

being of the general environment and human livelihood in particular, efforts by scientists and practitioners to address these challenges do not receive the necessary attention, which can help to draw the needed resources and expertise (Reynolds, et al. 2007). But, improving the conditions in these dryland ecosystems would therefore impact positively on the livelihoods of the populations in those areas by improving their food security, nutrition and social relations. The question of how to protect these dryland ecosystems from further degradation and to build resilience is therefore crucial. For instance, how can drylands be improved in order to cope with the challenges of extreme environmental events such as drought in the face of increased climate change and other environmental change impacts, where other coping mechanisms such as the planting of "fertilizer trees" and demarcation of grazing lands have not yielded the desired impact? But to tackle the challenges of drylands and to provide a sustainable approach to improving dryland ecosystems, the building of social-ecological resilience which frames and characterises the challenges in a social-ecological system perspective focusing on the interactions and interdependencies between the biophysical and the social aspects, is required. Insights on how these could be understudied via the system thinking approach toward isolating the underlying key principles that can enhance adaptation and development will deepen our understanding on strategies to implement to improve the livelihood of dryland dwellers. The following sections discuss the literature on the characteristics of dryland ecosystems at the global, Africa and the West African levels, then evaluate the contributions of the resilience concept in helping to strengthen these ecosystems by improving their social-ecological resilience to respond to change.

3.2 Characteristics and spatial extent of global drylands

Drylands are one of the most vulnerable biomes to climate change, and covers about 40 percent of the earth's surface, and broadly comprise of arid, semi-arid, and dry sub humid areas. They are predicted to be most unlikely to tolerate the 2°C warming threshold of the 2015 Paris agreement (Huang et al., 2017). Drylands are home to about 2.5 billion people in the world (90% of whom live in the developing countries) which is projected to reach about 4 billion people by 2050 (Cherlet et al., 2018; UNCCD, 2017a; Reynolds et al., 2007). They are areas where rainfall is scarce and usually unpredictable, thus with high variability year-round. Temperatures are also very high, which coupled with abundant solar radiation leads to high potential evapotranspiration. This condition affects plant growth in addition to biomass generation, which exacerbates conditions of poor soil as a result of the low generation of organic matter and highly reduced moisture contents in the soils. As a result, plant species

composition turns to change in favour of woody shrubs with its attendant risks. Furthermore, the high variability associated with drylands directly influences its primary production levels thereby exerting more pressure on the carrying capacity of the region (the quantity the region can support) by livestock production in particular (Tietjen and Jeltsch, 2007). Reynolds, et al. (2007) have suggested the following five features of the dryland syndrome that can determine sustainable development in dryland regions: high variability (precipitation, air temperature), low fertility, sparse population, remoteness and distant voices (opinions not captured in mainstream policy discourses). These together can work either to hinder efforts at achieving sustainable development or when harnessed properly could provide the necessary foundations upon which long-term measures can be applied, as short-term strategies have proved to be inadequate in addressing challenges in drylands. These changes have combined to set drylands on the path of desertification with its dire consequences on human well-being.

Subsequently, the United Nations Convention to Combat Desertification refers to desertification as land degradation in drylands due to various climatic variations and human activities (UNCCD, 1994). The Millennium Ecosystem Assessment (2005) defines land degradation as a process that leads to a long-term failure to balance the demand for and the supply of ecosystem goods and services. Desertification has been recognised as one of the major global change problems and continue to be on the agenda of the UN. Despite global awareness of the function and implication of the impacts of, and attention to desertification, success stories of combating and developing drylands in the world is scarce (Lucatello et al., 2020; Reid et al., 2014). But people living in drylands largely depend directly or indirectly on ecosystem services for their livelihood. However, such services of biodiversity, nutrient cycling, flood regulation, water, food and fibre are all under severe threat, especially from climate change variability (UNCCD/UNDP/UNEP, 2009), which exacerbates the effects of desertification. Consequently, sustainable management of land use under climate change in relation to ecosystem services requires a full knowledge on the system dynamics, and most especially in drylands where livestock production is predominant, supporting about 50 percent of worldwide production in arid and semi-arid areas alone (Tietjen and Jeltsch, 2007). Due to the peculiar conditions and dynamic nature of dryland areas, applying successful management practices to address the challenges and to meet the needs of dwellers of drylands has at best proved intangible. The socioeconomic and biophysical features of drylands have together constituted what has come to be known as the “dryland syndrome”, and that its dwellers are

the most marginalised in the world economically, ecologically, socially and politically (Reynolds et al. 2007, pp. 848).

Mindful of the challenges dryland communities face, but being also aware of the potential benefits that drylands can offer, which have not been utilised, especially that drylands in developing countries lack the needed investments to boost their abilities to enhance productivity and increase incomes. Against this backdrop, members of the Environment Management Group of the UNCCD committed to the following 2011 international drylands agenda, to:

1. Enhance the economic and social well-being of dryland communities in a sustainable manner
2. Enabling dryland communities to sustain their ecosystem services and make a contribution to global public goods
3. Strengthening the adaptive capacity of global drylands to manage environmental change, including climate change.

Appreciating the enormous hardship dryland communities continue to face and being determined to work together to identify and implement solutions to address and improve the conditions of its dwellers is highly needed. However, sustaining the various strategies and projects directed to enhance the well-being of the people and to strengthen their adaptive capacity against excessive impact of climate change requires an understanding of the underlying sociocultural principles that drive decision-making and choices. Such insights may not only foster cooperation, but will likely be successful in delivering desired outcomes by enhancing the capacity of the drylands social-ecological system to be resilient in the face of predicted increases in climate change impacts (Lucatello et al., 2020), and also leverage the principles of trust and respect for traditional knowledge to innovate and sustain resilience related strategies (UNEP, 2011).

3.3 Current state of African drylands

Africa is largely dry, with about 43 percent of the entire continent being classed as dryland, which is home to about 325 million people, who depend largely on the provision of ecosystem services. In fact, outside of the wettest areas surrounding the forest zones in West and Central Africa, the rest is made up of barren deserts, savannah, grassland, shrubland, woodland and dry forests (UNCCD/UNDP/UNEP, 2009).

Conditions for living in these areas are precarious and constantly under threat from climate change variability and impact. It has been projected that between now and year 2080 crop yields in Africa will decline by 20-30%, with a 100 percent expectation of frequent and intense extreme weather events. The continents median temperature is also projected in the same period to rise by 3.6℃ (UNCCD/UNDP/UNEP, 2009).

Consequently, due to the heavy dependence on the environment for livelihood, the already precarious state of drylands is made worse through a variety of challenges, such as urban expansion and unsustainable farming arrangements. The water systems supporting crop farming and livestock are seriously affected, soils continue to be degraded and unproductive, biodiversity is also in serious decline, etc (Reynolds, et al. 2007). Nevertheless, the increased temperature is likely to impact the poor water condition leading to soil moisture loss and the typical rain-fed agriculture prevailing in drylands. There are already deficits in the ability of African drylands to prepare and respond to the constantly changing conditions. But new approaches must be developed in order to build the resilience of, and improve the conditions of African drylands.

3.4 West African drylands and climate change implications for dryland ecosystems

West African drylands form about 7% of World's drylands with relatively high degradations and high population density compared to the other regions. Rainfall data in West Africa drylands has seen a dramatic decline over the years, with some of the northern parts which were semi-arid in the 1930s becoming clearly arid by 1960s (Put et al., 2004). Additionally, the region became increasingly unsuitable for millet or sorghum production in most years, with considerable high drought risks. The timing and distribution of rain is essential for crop growth and yield in rain-fed agriculture, and especially in semi-arid regions. Further, evapo-transpiration data, which is important in estimating the effect of drought stress risk of crop performance, suggests a high rate of continuous loss of water into the atmosphere causing crops to either die or yield far below optimum levels (Put et al., 2004). The potential rate of this process is the combination of the demand of the atmosphere with high temperatures, and the properties of the soil, which is shallow, and crops. With good policies and appropriate support, drylands can be productive and be able to improve the livelihoods of its dwellers, whilst contributing to the global agenda of poverty alleviation through strategies of mitigating and adapting to climate change. However, increased water stress, high levels of desertification and

soil salinisation are likely to occur in most drylands around the world. These changes are likely to lead to high increases in food prices in addition to high production and transport costs, impacting directly on the livelihoods of the large vulnerable populations of drylands who are already exposed to extreme drought and other weather events (Lucatello and Huber-Sannwald, 2020).

Six West African nations have large dryland areas (Senegal, Mali, Ghana, Niger, Nigeria and Cote d'Ivoire) where food production fluctuates annually. Cereal crops like millet and sorghum dominate these ecosystems. Population increases and rapid urbanisation in these regions have been challenging to the development. In the wake of increasing and accelerated rate of global environmental change, it is relevant to ascertain whether drylands are doomed to be physically degraded and desertified by humans, or whether they instead present an opportunity for sustainable development (Lucatello et al., 2020; Reynolds et al., 2007). Climate change is an amplifier of global changes in drylands directly affecting crop yields and agricultural systems, and its impacts are predicted to worsen in the next three decades, whilst reducing grassland productivity between 50 and 80% in arid and semi-arid regions (IPCC, 2015). Consequently, as drylands supports such large numbers of vulnerable communities by providing various categories of ecosystem services, they require increasingly adaptive management approaches with integrated biophysical, socioeconomic and institutional components, in order to build resilient local socio-ecological systems capable of responding favourably to changes. Thus, there is the need for insights and sharing of scientific, local and indigenous knowledge, ethics, wisdom and worldview, that will help to protect and improve dryland social-ecological systems to sustain livelihood of its dwellers.

3.5 Ways the resilience approach and systems thinking can improve conditions of African drylands

Conditions in dryland ecosystems are precarious as has been noted earlier. However, the focus of the international community as well as scientists on addressing the myriad of issues confronting the dwellers and impacting their well-being has not matched the magnitude of the problems. The contributions of science and strategies geared toward development of drylands at best have adopted short-term approaches (Robinson and Berkes, 2010), which have not yielded the needed positive and sustainable outcomes as a result of the peculiar nature of the variables involved having lengthy turnovers (e.g. soil fertility) and for that matter will require long-term attention. Consequently, strategies for the sustainable development in drylands must

have built-in mechanisms that respond to their coupled, dynamic and co-adapting nature, and how of their structure, function and interrelationships change over time (Reynolds et al., 2007). The resilience approach coupled with the systems thinking paradigm it adopts could be useful in a number of ways in helping to reduce further degradation and addressing dryland conditions.

Broadly, the resilience and systems thinking approaches set the boundaries and isolates the constituent parts of social-ecological system (also known as the human-environment system), while stressing that all the parts are connected in an interwoven fashion. It is a complex adaptive system with many multiple variables interacting at varied scales and time. But not all variables carry equal weight and effect, and that each variable does not operate in isolation and therefore not important by themselves except understudied together. The following features of the SES are highlighted for consideration when applying the resilience approach, such as the stability domains (basin of attraction), the magnitude and direction of perturbations needed to push the system over the tipping point or threshold level into a new domain, where the variables reorganise interactions around the new basin of attraction (Robinson and Berkes, 2010; Walker and Salt, 2006; Gunderson and Holling, 2002). Understanding how these features operate is helpful to determine the stability domains of systems and the amount of perturbation or disturbance sufficient enough to push them over their critical threshold levels into a new system. Such insights could help to define the capacity to maintain system function, and for that matter its resilience to withstand shocks (Robinson and Berkes, 2010).

Moreover, the resilience approach highlights that humans and the environment in which the live could better be studied and understood when addressed together since they are coupled social-ecological entities interacting together and exerting influence on the outcome of each other. Both the biophysical as well as the social contexts depend on each other. Outputs from one most of the time determine the outcome of the other, which consequently feeds into the originating system – the feedback loop phenomenon (Robinson and Berkes, 2010; Richmond, 1993). Consequently, understanding of how the linked dryland biophysical and socioeconomic structures and field activities drives degradation is a critical necessity in addressing critical challenges dryland dwellers are faced with. In this vein, the resilience thinking and approach helps to isolate the relevant social-ecological variables responsible for the present structure and functioning, the magnitude and strength of interdependencies for adopting effective strategies, and to determine and address the consequences of threshold levels, thereby preventing a shift or transformation into undesirable states (Gunderson and Holling, 2002).

Furthermore, Reynolds et al. (2007) identified five resilience related and helpful principles through the Drylands Development Paradigm (DDP), and showed how these are important in drylands and also highlighted their implications for research, management and policy geared toward the development of drylands:

- dryland human-environment systems are coupled, dynamic, and co-adapting with no single equilibrium point. This resonates with the CAS nature of coupled social-ecological system as suggested elsewhere in the resilience literature (Biggs et al., 2015; Walker and Salt, 2012; Gunderson and Holling, 2002). Therefore, strategies require a simultaneous consideration of both the ecological and human drivers of change.
- slow variables are crucial in determining critical dynamics of drylands (also in Biggs et al. 2015), but not all variables carry equal weight in relation to influence of system dynamics.
- thresholds in key variables are crucial to determine the state or condition of a human-environment (H-E) system.
- drylands and for that matter H-E systems are hierarchical, nested, and networked across multiple scales. The systems must be managed at the appropriate scale, while considering carefully links to other levels of interaction. We should scale-match strategies and management as much as including contextual elements.
- maintaining a body of up-to-date local environmental knowledge (LEK) within drylands is necessary especially where there is little research. It also enhances slower acquiring experiential learning and feedbacks.

Applying the above principles from the DPP and similar ones suggested elsewhere in the resilience literature (Biggs et al., 2015; Walker and Salt, 2012; Gunderson and Holling, 2002; Robinson and Berkes, 2010) to drylands is helpful in many ways. The following perspectives can help to build social-ecological resilience in dryland ecosystems.

- Draws attention to the existence of nonlinearity assumptions and the CAS properties of drylands, thus, SES have multiple equilibrium states
- Stresses that neither the ecological nor social systems can be understood adequately on their own, a better approach is via the couple social-ecological system
- Provides some of the conceptual tools to analyse linkages and understand complexities in SES
- Highlights the use of adaptive approaches

- Recognises that variables carry differing weight of influence on the whole system, and thresholds within slow variables are more crucial, but difficult to capture
- Increases understanding of the varied feedback loop systems present in dryland ecosystems, which improves management strategies when identified and examined carefully
- Suggests that we adopt effective inclusive plans through brainstorming
- Helps to develop integrated approaches to understand and address the complex interactions in drylands

In a nutshell, all strategies and interventions geared toward safeguarding dryland economies and livelihoods must begin with a critical integrated assessment of how such a complex and dynamic ecosystem functions and how the people have coped and survived over millennia. This is what the application of the resilience approach in assessing coupled SESs offer, in order to deepen understanding and its application in various intervention options in drylands improvement and function.

Chapter four

General methodological framework for the study

4.1 Chapter overview

This chapter presents the research design and methods of data collection the study adopted to collect and analyse the required data to achieve the objectives of the research and to answer the research questions. The study broadly applied a qualitative research methodology under an interpretive paradigm to explore context-specific principles and critical factors that improve adaptive capacity and build social-ecological resilience in coupled Social-Ecological Systems. Specifically, the study focused investigations on understanding of key principles and factors underlying decisions and choices, and their implications for building social-ecological resilience in a semi-arid region in Northern Ghana. But it has been argued that laying out a detailed outline of what design to follow and the methods to use, in order to achieve the aims of a project are crucial if the findings could be more useful and replicable (Creswell, 2014).

Consequently, this thesis adopts an exploratory case-study design and employs a mixed method data collection approach to answer the stated research questions: (1) how do households and communities respond to the impacts of environmental stresses? (2) what key principles underlie peoples' responses to environmental changes, and why? (3) what evidence is there that these principles are ecologically relevant in building resilience, whilst remaining relevant to the local people? The study is largely framed in a qualitative research design which is helpful especially, in the initial assessment by identifying system characteristics and dynamics, and how the system changes in the face of recurrent episodes of droughts and other forms of environmental changes. Furthermore, this methodological approach is supported by, and has been used in several studies (Gonzalez-Cruz et al. 2015; Gordon and Enfors, 2008). Roncoli, et al. (2009) for example in their study on farmers' perceptions about climate change have especially argued for the use of participatory and qualitative approaches in data collection and processing. Moreover, investigations conducted in similar settings and contexts have also utilised the qualitative-participatory approaches (Gonzalez-Cruz et al., 2015; Nyantakyi-Frimpong and Bezner-Kerr, 2015; Gordon and Enfors, 2008), which this study follow.

Thus, this methods section outlines the framework by which the stated research questions and aims were achieved, and is structured as follows: It continues after the overview to outline some methodological considerations in conducting a social research, and expounds on the underlying philosophical foundations of the study, justifying the merits of utilising a mixed-

methods strategy to underpin the case-study research design adopted. The succeeding parts go on to discuss the selection of the study district and communities followed by a description of the process of identifying participants and overall sampling strategy. The concluding section explains the specific approach of data gathering and analysis.

4.2. Methodological considerations underlying the research

The methodological approach employed in the context of the research objectives is generally qualitative, though preceded by a quantitative survey. Qualitative approach has been identified as a form of social inquiry that focuses on the way people interpret and make sense of their experiences and world they live in (Corbetta, 2003). This approach is underlined by the belief of interpretivism, which suggests that there is no single, tangible reality. Instead, there are multiple co-existing realities. In other words, it states that reality is seen from the individual perspective and embedded in the context, as opposed to being universal (Flick, 2002). In light of this understanding, the reason for resorting to this approach is the opportunity it offers for eliciting multiple perspectives on the aim of untangling the underlying principles of building resilience. It is specifically useful in exploring how society respond to changes and impacts, and to examine what social-ecological factors contribute to the present living conditions. Consequently, the interpretative paradigm of research which focuses on unravelling the underlying meanings of activities, in this case responses, yields itself a better philosophical focus for this study. Other paradigms such as the positivist approach that focuses deeply on reliable and valid methods, and the pragmatics that views methods that solve problems as the only best approaches, may not be suitable for this study. The study compares a number of research paradigms below and justifies why the interpretivists' approach is the most appropriate for this study.

4.3 The foundations of interpretivist research

This thesis draws on the interpretivist paradigm as its philosophical foundations, which is a dominant response to positivism in relation to ontology (theories of what the world is) and epistemology (theories of human knowledge and how it can be known). This study stresses attention on the interpretation humans bring in their relationship with the environment and how this influences their response to change. Additionally, the approach affords generalisations made from the study to be more practical and context-specific but replicable in similar circumstances. Moreover, applying case-studies approach and being guided by reflexivity in research (where the researcher keeps reflecting systematically throughout the research)

provides the contexts within which specific interpretations, meanings and definitions are ascribed to phenomena based on the living-world of researchers and potential respondents (Weber, 2004). For this reason, the thesis continuously reviewed researchers' perspectives, and acknowledged possible influences to address to minimise these in order that meanings and interpretations that are plausible, credible and dependable can be established. Other philosophical paradigms are discussed in contrast with the interpretivists approach below.

Generally, the positivist approach to research centrally holds the view that in order to produce sound knowledge it is essential to follow explicit procedures or methods. The rationale for this is that such explicitness serves to eliminate the biases that arise from the personal and social characteristics of researchers. This feature is what is sometimes referred to as procedural objectivity. Subsequently, reliance on explicit or transparent procedures is also seen as providing the basis for other researchers to replicate an initial study, and replication is sometimes regarded as essential in order to test whether the knowledge produced is sound (Creswell, 2013). But interpretivists believe strongly that humans, and for that matter society unlike atoms, chemicals, or even most non-human forms of life – actively interpret or make sense of their environment and of themselves, that the ways in which they do this are shaped by the particular cultures in which they live, and that these distinctive cultural orientations will govern what they do. Thus, diverse ways of life, and associated beliefs about the world, can be found, both at different points in time and coexisting (peacefully or in conflict) at any one time (Weber, 2004). Given this, it is suggested that any attempt to find universal causal relationships located in some fixed human nature or mode of life is futile, thereby challenging the central tenet of positivism of explicit methods and procedures. Furthermore, interpretivists argue that we cannot understand why people do what they do, or why particular institutions exist and operate in characteristic ways, without grasping how people interpret and make sense of their world (Weber, 2004). In other words, without understanding the distinctive cultural characteristics of people's beliefs, attitudes, etc, we miss fine details of how our world operates. However, this also has important implications for how we can gain knowledge of those phenomena. The very methods that positivists use such as experimental control and reliance upon standardised questionnaires to ensure comparability of response across people – assume that there are relatively standard patterns of causal relationship, or at least calculable probabilistic relationships, among psychological and/or social phenomena (Weber, 2004). Interpretivists reject that assumption and therefore employ other ways of trying to understand people's perceptions and attitudes, how these are shaped by cultural context and how they

inform actions, thereby encouraging a shift towards qualitative methods of research (Weber, 2004). Moreover, interpretivism carries different impression from positivism about what is required in order to understand people's perspectives, attitudes, or beliefs. Whereas positivism assumes that, for example, attitudes can be documented by getting people to respond to a questionnaire, interpretivists argue that all research methods involve complex forms of communication, and that coming to understand other people necessarily relies on researchers having both the necessary background cultural knowledge and skills and a willingness to suspend prior assumptions so as to allow understanding of other people's orientations to emerge over the course of the inquiry (Weber, 2004).

In summary, therefore, interpretivism carries the following implications for research: First, rather than setting out to test hypotheses or to find recurrent patterns of causal or probabilistic relationship, it requires the researcher to adopt an exploratory orientation in order to try to learn what goes on in particular situations and to come to understand the distinctive orientations of the people involved. Thus, it is assumed that what is discovered may well be different from what was initially expected. Equally important, any tendency to dismiss other people's attitudes as irrational must be resisted. Instead, the research must be carried out on the assumption that these attitudes make sense to, and are seen as justifiable by, the people concerned. The aim is to discover the 'logic' or rationality of what may at first seem strange, irrational, or even evil. This, it is argued, is an essential requirement not just for explaining, but even for describing people's behaviour and the social institutions to which it relates, their sources and consequences (Creswell, 2013). A second implication, closely related to the first, is that the data should be structured as little as possible by the researcher's own prior assumptions. So, rather than setting out to observe a situation with a pre-specified set of categories of events to identify, or asking questions in an interview that are designed to elicit pre-determined differences in attitude, the aim (initially at least) should be to collect data in the most open-ended fashion possible; in the case of interviews, for example, by trying to get the informants to talk in their own terms about phenomena relevant to the research topic. Therefore, this study utilises in-depth and key informant interviews, focus group discussions, observations and a survey to understand people's behaviours and underlying principles that influence their decision patterns and choice. The social capital concept which this thesis adopts as the main analytical framework for data analysis and presentation, is described below.

4.4 Social capital as the underpinning analytical framework

Since the research is more exploratory in nature aimed at elucidating understanding of how 'events' as processes impacts society and how people's responses are geared toward making the social-ecological system more resilient against increasing internal and external drivers of change such as climate change, it should better be addressed by applying social capital conceptual framework, which broadly refers to the benefit and power of networks and relationships amongst people within a group, community and in an area to mobilise collective action, strengthen trust and enhance cooperation in support of social goals (Andriani, 2013). More details about the concept are also presented in chapters five, six and seven. Moreover, Putnam (2000) refers to social capital as the connections that exist between people and the norms of reciprocity and trustworthiness that area generated for the good of members. This kind of capital is different from physical capital that focus on physical objects, as well as human capital which relates to the properties of individuals. With social capital, the public or society is the focus, interrogating the factors and norms that promote public good, such as trust, reciprocity and collective action in order to maximise favourable attributes whilst ameliorating unfavourable negative tendencies that may work against public benefits (Andriani, 2013). Consequently, with the overarching research aim of understanding the underlying principles that can build social-ecological resilience of drylands in mind, analysing the study via the social capital conceptual framework will not only help to identify these principles, but can elucidate on the nature of interconnections between individuals, households and communities. Such knowledge and insights are likely to inform and reinvigorate climate change resilience strategies that can better support dryland dwellers against the impacts of recurrent environmental changes. Some of the most common approaches utilised to measure social capital, as presented in Andriani (2013) include conducting census of groups and group memberships (Putnam, 1993), the use of survey data on the level of trust (Fukuyama, 2001), civic participation (Casey, 2004), and crime rate analysis (Lutz and Lutz, 2004). But the present study will use survey data and interviews to understand underlying principles of people's decisions towards mobilising social capital to facilitate and enhance resilience processes.

But it has proved elusive to have a generally acceptable definition of social capital as an analytical concept for empirical assessments, and as a result, some find it difficult to accept the results and outcomes from studies that apply social capital (Sabatini, 2006). Fine (2002) for example views social capital as just a metaphor because its definition continues to be elusive. Furthermore, Fine (2002) believes that the notion of social capital has become a vehicle by

which everything dysfunctional in society is explained. Despite several analytical approaches gaining currency in research (Nyantakyi-Frimpong and Bezner-Kerr, 2015; Newsham and Bhagwat, 2016), such as political ecology, which prioritises politics and power relations, they may not always be adequate and complete enough to capture and offer concrete description of the possible interconnections between the interests of individuals, communities (as social capital can offer), and the underlying processes of resilience. Consequently, the study largely identifies and conduct historical analyses of the choices and decisions of participants to gain understanding of the processes and patterns, and the responses adopted to cope and to build social-ecological resilience, using the Daffiama Bussie Issa district of the Upper West Region of Northern Ghana as case study.

4.5 Case-study approach

This study adopted the case-based methods generally are suitable for inductive scientific enquiries as against top-down deductive approaches, where one uses case analyses to demonstrate theory (Blommaert and Jie, 2010). With this approach therefore, theory emerges from the analyses of data obtained in particular case(s), not the other way around (Tie, et al., 2019; Glaser and Strauss, 1967). However, generalisations in case-study approaches do not reside within the cases but emerge from the cases based on the theoretical background one brings and applies to the data. Shulman (1986:12) puts it this way: that 'Generalisation does not inhere in the case, but in the conceptual apparatus of the explicator'. This simply means that though generalisations are perfectly possible in case-based methodologies, it is a function of the particular conceptual application utilized by the researcher.

4.6 Mixed methods

The epistemology that supports qualitative research views knowledge as underlined by the subjective denotations of individual and collective experiences by which meanings are ascribed to certain objects or things (Creswell, 2013). Similarly, the ontology of the qualitative approach signals that reality is composed of multiple persuasions, making it a social process that generates meanings through varying human conceptions, actions and experiences. (Creswell, 2013; Creswell and Clark, 2011). Consequently, the methodology (i.e., theories of how the world can be understood) applies an objective examination of the varying perspectives from participants on a particular situation (Creswell and Clark, 2011). This thesis therefore adopts a bottom-up approach by using the responses of participants to build themes and produce a "theory". On the other hand, the epistemological foundation upon which the quantitative

approach is prefixed reflects the understanding that knowledge is gained from experience which is demonstrable via experiential measurement (Creswell, 2013; Creswell and Clark, 2011). Whereas the ontological aspect is based on the postulation that the reality is particular, which can directly be measured and accepted as evidence (Creswell, 2013; Creswell and Clark, 2011). Thus, the quantitative approach took a top-down process which may add or challenge a theory on a certain focus of research. Through the quantitative aspect of the research, this thesis could obtain a broader spectrum of evidence necessary for making generalisations. However, both the qualitative and quantitative approaches are viewed to operate from opposite ends of a continuum requiring a third approach that harnesses the potentials, while ameliorating the apparent weaknesses of these differing worldviews (Johnson and Onwuegbuzie, 2004).

Subsequently, this thesis although adopting largely a qualitative position employed some quantitative methods of data collection like the use of questionnaire, leading to the broader mix-methods approach to social research. However, the use of the mixed methods approach is justifiable on the basis that investigating complex research problems like how society perceive and respond to changes that impact both humans and the environment in which they live require broader spectrum of approaches. Hence, this thesis adopted a pragmatic philosophical approach, which in a way connects the ontological and epistemological differences of the qualitative and quantitative in a manner to foster complementarity and affords a deeper understanding of the research whilst permitting for the generalisability of the findings of this thesis across relevant scholarly spectrum (Creswell, 2013).

4.7 The research design for the study

4.7.1 Selection of the study area and communities

Location

The selection of the study district and communities was done using a specific criterion based on the convergence of several theoretical and empirical postulations like the changing land use characteristics in the off-reserve areas and the proximity of study communities to the Gbele Game Reserve and the impact on agricultural fortunes, area demography, existence of variant resources access forms and on-going sustainable resource management intervention programmes. Selection of the Daffiama-Bussie-Issa district was informed by it being the most centrally located district in the Upper West Region bordered by five other districts (Figure 4.1), and also as the region's 'food basket' highlighted in interviews with the District Chief Executive (DCE) and the Deputy District Coordinator. It is the newest district of the region

only created out of previously the Nadowli district in 2012 by Legislative Instrument 2100 (Republic of Ghana, 2012). The district has a land area of 1,315.5 square kilometres and within Latitude 11°30" and 10°20"North and Longitudes 3°10" and 2°10"West (Ghana Statistical Services, 2014). Issa the district capital is 57 kilometres from Wa the regional capital. The unique central positioning of the district makes it one of the critical areas to conduct such investigation of complex human-environment interactions as the project seeks to accomplish. Moreover, the flows between DBI and the five adjoining districts strengthens this position, and one can safely suggest that what affects the larger region can have significant impact on the district via its neighbours and vice versa. Accordingly, an initial research visit to the Daffiama-Bussie-Issa district was undertaken by the researcher in May 2016 mainly to introduce the project to the people and to seek their approval and support. The visit afforded first-hand experience and interactions with key stakeholders such as interviews with the District Chief Executive (DCE), the deputy district coordinating officer, district assembly leaders for all the communities earmarked for the project.

The six communities, Daffiama, Fian, Bussie (western communities), Kojokperi, Tabiesi, and Issa (eastern communities) (see Figure 4.1 and Table 4.2) selected for the study have a total population of 13,523 representing 47 percent of the 20 largest communities (28,882) in the district, and 41 percent of the entire population (32,827) of the district (Ghana Statistical Services, 2014). Generally, the selection of the study communities was based on the researcher's local knowledge, documentary evidences and some local expert opinions of their representativeness. Crucially, the first four are also the top four largest communities in the district, and Issa which is the capital is the seventh of the 20 largest communities. The Upper West region of Ghana shares a border with Burkina Faso to the north and the Cote D'Ivoire to the West. It is insightful for this thesis to focus analysis on the dynamic interactions that occur across these borders and their implications on the capacity of communities to respond to environmental change. The selection of the DBI district as the study area is justified as the most central location in the region with connection to most of the other districts in the Upper West Region. This creates opportunities to explore further and to understand the benefits or otherwise of boundary effects on the capacity of communities to become resilient. Consequently, the analysis of the influence of the Gbele Game Reserve (forest) in the east on the adjoining villages through the edge-effect concept and natural resource use, and how this has led to nearby villages engaging entirely in farming as against faraway communities in the west part of study area who may also have access government jobs is presented. The chapter

also outlines the procedure for the fieldwork investigations and data collection processes, and reports on the methodological limitations and ethical considerations. Notwithstanding the generally homogenous nature of the social, economic and environmental characteristics of the study villages, there are some differences that were noted, which can be expected to influence certain aspects of the dynamics of community living. The east part, bounding the Gbele Game Reserve, provides a conducive micro-climate for agriculture so that the inhabitants engage predominantly in food crop farming. They are also predominantly Muslim and relatively less developed compared to their counterpart in the west, who are largely Christian, relatively commercial and less agrarian (see Table 4.1).

Land tenure and ownership arrangements in the district follow identical rules anywhere in the District that recognise land and other natural resources as common property held in trust for the ancestors and gods. Therefore, it is believed that any contravention relating to ownership will result in some form of punishment from the ancestors. Traditional elders who are deemed the custodians of the land must ensure it is not lost, but kept for the use of the people. It is believed failure in doing this will attract repercussions. Land tenure and ownership are deemed to be customarily determined and therefore are not subject to contestations, making land ownership secure. Evidently, 70 out of 98 survey responses (constituting about 71%) on the question of whether they perceived ownership of their land as secure indicated that land ownership in the area generally is secure. Few land issues that emerge between families and individuals are resolved by the landlords amicably. Family lands comprised all parcels of land recognised as belonging to a particular lineage through inheritance from their forefathers by virtue of early settlement. Such lands are usually held in trust by a head for the common benefit of the other members.

Table 4.1: Summary profile of the East and West parts of the Study Area.

East and west of study area	Geographical characteristics	Socioeconomic characteristics	Religious characteristics	Average HH Size
Western communities	• Located farther away from the Gbele Game Reserve	• Secondary schools • Government Institutions	Dominant religion is Christianity	11.4

	• Not well drained by major rivers and stream • Has much drier micro-climate	• Catholic Church Missions • Petty trading is common		
Eastern communities	• Shares boundary with the Gbele Game Reserve • Milder micro-climate • Relatively richer soils • Drained by a number of rivers and streams	• Predominantly farmers • Petty trading relatively less commonplace • Lacks infrastructure such as schools and health facilities	Dominant religion is Islam	10.9

Source: Fieldwork, 2017.

It is interesting to note the influence of geographical location on the type of livelihood activities that predominate in communities and determine the level of development and access to natural resources. The western part is relatively developed with amenities such as secondary schools, hospitals and improved transport connections, whereas the eastern part is generally dominant in farming and forest related activities (Table 4.1).

The differences cut across religious affiliation and practice (Table 4.3), which also largely determine the kinds of social and economic activities predominant in parts of the study area. For example, the local alcoholic beverage (pito) that women brew and sell to augment household income, may not be an option for households in the eastern communities where a large proportion practice Islam, which forbids alcohol use. Also, the level of infrastructure such as schools, hospitals and water sources for community use, serve as a dichotomy between the east and the west of the study area. The east is dominated by the Sissaala tribe who are also typically farmers supplying most of the food needs of district and parts of the Upper West Region. The west on the other hand consist of the Dagaabas who also have a greater proportion of high school certificate holders (Ghana Statistical Service, 2014). Consequently, people in the west engage in more office jobs in government departments, the educational and the health sectors, thereby affecting the volume of farming that is done in this part of the district. Although, western communities are relatively farther away from the main forested areas in the east affecting the level of access and use of NTFPs, they may have the economic power to buy from the local markets. Overall, the discussions above signal the people's capacity to respond to climate change is influenced in one way another by the gender, religious affiliation and their location within the study area. Gender considerations seem to affect to some extent the level of representation of women in decision making. This situation is exacerbated by one's religious affiliation where women in the predominantly Muslim east cannot engage in liquor businesses to boost their and the family's income. Additionally, the western communities could be employed in some way by government agencies and NGOs to give them an alternative if their farming fails as a result of the insistent effects of climate change.

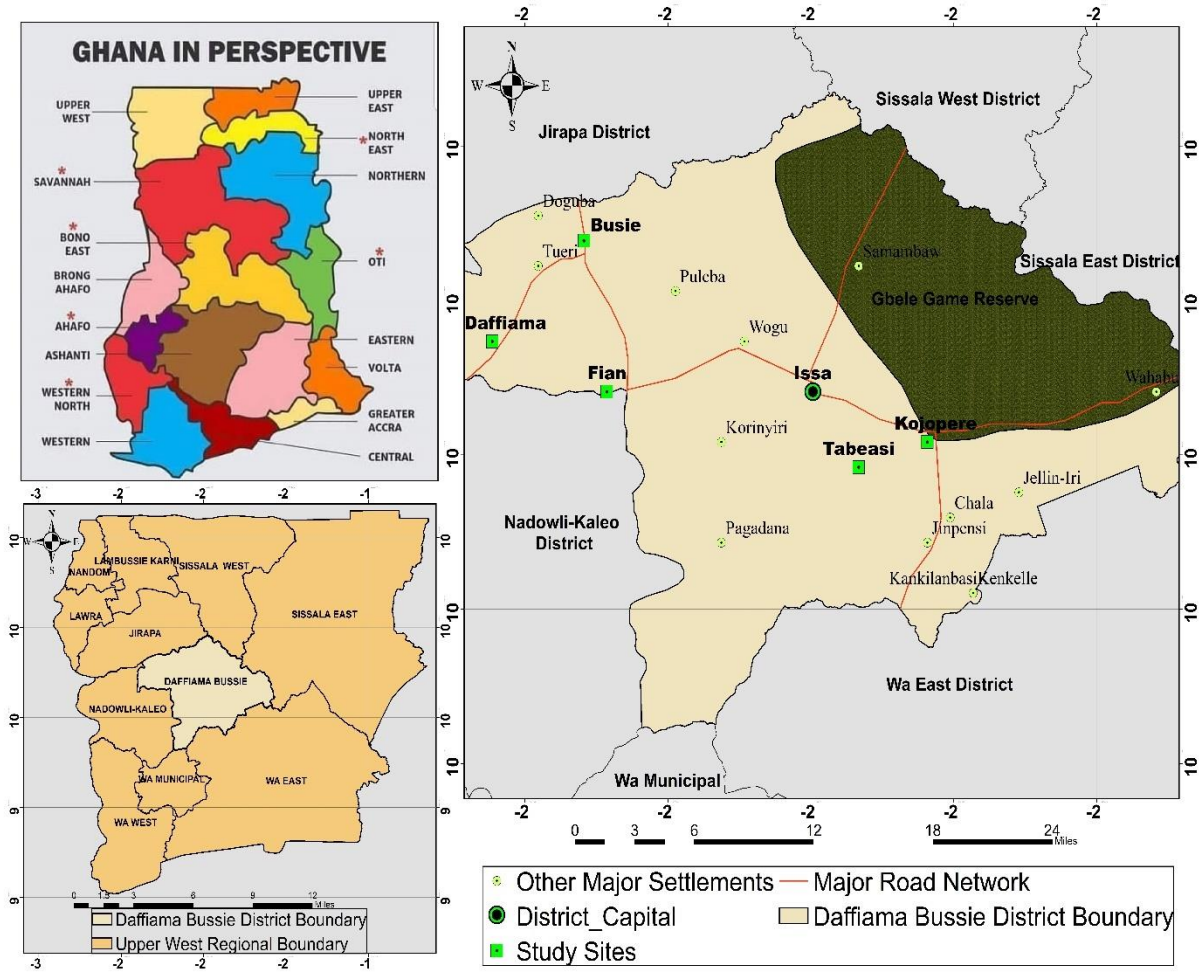


Figure 4.1: Study Area Map: Daffiama Busie Issa District & study communities

Socio-political characteristics

The Upper West Region has the largest rural household nationally of 79.5 percent, and second largest household size of 6.7, only after Northern region, which has 7.7 (Ghana Statistical Services, 2014). Consequently, the Daffiama Bussie Issa district has no urban communities (>5000 inhabitants) as at the 2010 census. The district has a population of 32,827 representing 4.7 percent of the regional population, and is made up of 48.7 percent male and 51.3 female. The district population is generally youthful with 42.3 percent below 15 years, and with a total age dependency ratio of 95.3 percent. Of the population 11 years and above, 42.3 percent is literate with males accounting for 48.2 percent as against 37 percent of females. And 60 percent indicated could speak and write both English and Ghanaian languages (Ghana Statistical Services, 2014). Almost 78 percent of the population is engaged in agriculture, forestry and fishery ventures; with the private informal sector alone by far the largest employer across all

sectors (95%). Agriculture, which is the mainstay of the people in the district, engages around 85 percent of the economic active population. But, 81.9 percent households engaged in agriculture, which is mainly subsistence and characterised by low output levels. Maize, sorghum, millet, rice, soya beans, groundnuts and yam are the main food and cash crops produced in the district, with mangoes and cashew as the main tree crops. The cultivation of these crops is complemented by livestock rearing (goat, cattle, sheep and fowls), which supplements family resources in times of cop failures. There is an average of 14 animals reared per household, showing that livestock rearing is popular in the district, with goats, cattle and sheep more predominant among ruminants (Ghana Statistical Services, 2014).

Political administration in the Daffiama Bussie Issa district is steered by the District Assembly, a body made up of the General Assembly, departments of the assembly, three Area Councils and Unit Committees. The General Assembly, which is the highest decision-making body, comprises the District Chief Executive, the Member of Parliament (MP) and Assembly members. Out of 23 Assembly members, 15 are elected from the various electoral areas and the other 6 appointed by the government in consultation with traditional leaders and interest groups in the district. The Assembly has an elected (by 2/3 members) Presiding Member, whose main responsibility is to preside over the General Assembly meetings, whereas the DCE (appointed by government with 2/3 members support) oversee all the affairs of the district. Traditional authorities play crucial and varied roles in administration, and the district has three main paramountcies at Daffiama, Bussie and Issa (Ghana Statistical Services, 2014). By religious affiliation, the district is 51 percent Christian, 37 percent Islam, 8 percent Traditionalist and 4 percent has no religion (Ghana Statistical Services, 2014).

Culturally, the district is made up two major ethnic groups the Dagaabas and the Sissalas, with the Dagaabas constituting about 96 percent. There are several festivals celebrated in the district, but notable ones are Dunyee (celebrated in January meant to foster community unity) and Jinbentim (celebrated annually to pacify ancestors and seek their continual protection). Such festivals and the associated rituals foster cultural traditions of the people, strengthening their dependence on the ancestors' blessings regarding all activities they embark upon. Thus, almost all their decisions and choices are widely influenced by cultural practices.

Climatic and vegetation characteristics

The climate of the region is made up two distinct seasons; the dry season which roughly runs between November and March, and the wet season between April and October. The annual

rainfall, which is variable, decreases northwards between <900mm and 1,111mm. In some years the region experiences short dry spells of about 3-5 weeks immediately following the first rains between April and May, a condition that results mostly in serious crop damage. The Daffiama Bussie Issa district lies within the Tropical Continental Zone and has a low-lying undulating topography, and an annual rainfall restricted to 6 months (May-September). Altitudes ranges from 150 to 300 meters above sea level, but some parts rise to about 600 metres. Its low-lying land area is also poorly drained with no major rivers running through, except some small-scale dams and dugouts that are used dry season gardening and for watering cattle. These water sources scattered around the district and some can be found in Fian, Tabiesi and Dakyie. This situation seriously affects agricultural activities, especially in periods where the main raining season delays or fails. But the researcher witnessed first-hand during the initial fieldwork visit in May 2016, how the dugouts, especially those nearer to major road networks are gradually being polluted by transit cargo and commercial vehicles users who use the district to connect to the neighbouring Upper East Region, and the Republic of Burkina Faso. The commuters sometimes clean their vehicles close to the water sources and in the process pollute them with washing chemicals and oil substances, which drain into them. Additionally, people dispose of empty drink cans and other waste into the water bodies (see Figure 4.2). Annual mean temperature is 32℃ and the mean monthly figures ranges from 36℃ in March to 27℃ in August (Ghana Statistical Services, 2014).

Major rock types found in area are Granites with some Basement complex in the east, and these rocks hold considerable quantity of water, which present the potential for drilling boreholes and sinking wells for domestic and other uses. Laterite, Sandy and Sandy Loam (Savannah Ochrosols) are the predominant soil types found in the district, but these generally have low organic matter content and nutrients resulting from the absence of serious vegetation cover due to bush burning, overgrazing, over cultivation and massive erosion. Consequently, the soils are heavily leached and are generally less fertile. But the soils found in Issa and Tabiesi are sandy loams, which are relatively fertile and supports the cultivation of crops such as yam, cereals and legumes.

Figure. 4.2: Oil pollution of dugout pond water by commuter vehicles shown by the arrows.

The vegetation of the district lies within the Tropical Continental or Guinea Savannah Woodland characterized by shrubs and grassland with scattered medium-size trees. The Guinea Savannah, however, is characterized by pro-climax economic tree species such as Ebony and Mahogany, with Shea (*Vitallaria paradoxa*) and Dawadawa (*Parkia biglobosa*) also predominant (and these are protected due to their economic value) (see Figures 4.3 and 4.4 respectively). The pressures of the annual bush fire episodes coupled with population pressures have led to considerable degradation, but the economic trees are resistant to drought and fire and provide major source of income to women. Additionally, the economic trees present opportunities for increased employment openings as the population is largely youthful, through the establishment of processing industries. Severe soil erosion for example has occurred in steep slope areas that are also well dominated by people. Local collection of trees provides all domestic needs of fuelwood and charcoal, construction materials for houses, cattle kraals and fencing. The shorter shrubs and grass also provide fodder for cattle and other livestock (Ghana Statistical Services, 2014).

Figure 4.3: Shea nut Tree

Figure 4.4: Dawadawa (*Parkia biglobosa*) Tree

4.8 General data sources and description of overall sampling strategy

4.8.1 Qualitative sample and sampling procedure

Amongst the features of the qualitative approach is the intrinsic challenge of predefining the research design preceding to the start of the research and the relatively small sample size involved (Denscombe, 2010; Miles and Huberman, 1994). The selection of targeted respondents is normally through the non-probabilistic sampling techniques (Miles and Huberman, 1994; Punch, 2014: 161). This is premised on the fact that the qualitative research process is one of discovery (i.e., inductive), not of hypothesis testing as laid out earlier (Miles and Huberman, 1994). Thus, within the confines of this study, the gathering of qualitative based data from relevant stakeholder representations in the study area such as farmers, customary/ traditional authorities, local resource managers, district assemblies, opinion leaders etc., is required to adequately address the research questions directing this investigation.

The purposive and snowball non-probabilistic sampling techniques were adopted for this study (see Figure 4.7 for details on the number sampled in each of the 6 villages). The purposive sampling technique is seen as an effective way of gaining the needed information by focusing on items or persons of interest most likely to possess the experience or expertise to afford requisite information and insights valuable to the research (Denscombe, 2010; Black, 1999). The snowball sampling on the other hand, encompasses the process of identifying a suitable respondent who also help to recruit another suitable person for the purposes of the research (Denscombe, 2010: 37). Using the snowball technique enables samples to be quickly

assembled in contexts where none exist, despite other viewpoints that it does not ensure the possibility of representative sample to be drawn (Denscombe, 2010).

From the foregoing, the selection of targeted respondents during the qualitative data sampling involved a series of iterative steps from the broader to specific level. The approach started with the identification of all relevant stakeholders at the regional and district levels (District Assembly, Traditional Authorities, Agriculture extension officers, etc.) who provided institutional viewpoint on the general resource management dynamics and livelihood change in the study area. Selection of village-level respondents (Chiefs and elders, farmers and other opinion leaders) followed. This group are versed in village history and local dynamics, and were recruited via the purposive and snowballing techniques. However, care was taken not to miss a lot of the unique individual or group characteristics that can enrich the quality of the research. Subsequently, participants were grouped into particular clusters such as men, women and 'experts' during the FGD sessions in order to capture unique group contributions to enhance the understanding of the subject understudy in the selected communities.

4.8.2 Quantitative sample and sampling procedure

Generally, the purpose of the questionnaire survey is to capture background information on household characteristics, demographic dynamics, major agriculture-related events, food secure status and general perception of environmental changes and resilience. The study area and communities are largely agrarian with agriculture constituting the primary means of livelihood. This coupled with the specific dictates of the study justifies the exclusive focus on farming households in the selected communities as the target population for the quantitative survey. In other words, the underlying argument here is that focusing on farming households is imperative in obtaining relevant answers necessary for fulfilling the objectives of the study given their pivotal role in resource management as well as the different conditions that affect agriculture, access to, and use of land resources and outcomes.

For the purposes of this study, the number of related or unrelated persons who live together in the same housing unit, who acknowledge one male or female as the head of the household, who share the same cooking arrangements, and are considered as one unit is preferred as definition for a household. Subsequently, the random sampling technique was applied in the selection of the households and it was undertaken by the researcher and four research assistants who constituted the survey administration team. The survey questionnaire was developed through review of literature and pre-tested for clarity, content and context. As data on the number of

households and farmer populations (to constitute the sample frames) in the respective communities is almost non-existent, and coupled with the dispersed nature of housing arrangements, typical in the study area, the team conducted walks through village paths and streets to randomly sample every fifth house until the required sample size (20 per village) is attained, following Nyantakyi-Frimpong and Bezner-Kerr's (2015) work in a similar setting. Due to the homogeneity of the study population in terms of the sociocultural, economic and physical conditions, the six villages were selected for the survey and in-depth interviews and were treated as one case study (Gyasi and Awere, 2018), therefore each received 20 questionnaires. Preliminary analysis of the survey data was then followed by the qualitative data collection, which was carried out in an iterative fashion, where data collection and analysis occur concurrently to enable probing further as new perspectives emerge and additional data required.

4.9 General data collection approach

Taking due cognisance of the general objectives of the study and the key research questions stated earlier, a cross-sectional approach was devised progressing from a broad-based focus to a more narrow and intensive focus on sampled households in the study communities. Figure 4.5 shows a diagrammatic display of the various stages of data collection and methods, and how the methods interlink to achieve the broad aim of the thesis, which was to understand the key considerations of households and community responses to changing conditions, focusing on the principles that underlie their choices, and how these principles improve social-ecological resilience. In order not to constrain further people's time on the farm, market, office or home, the researcher took every necessary step not to overload respondents with questions and activities throughout the entire data collection exercise. Permission for visits either to participant's farm or home, for example, was negotiated in a manner that afforded them ample time and space to organise well for the visits. Furthermore, relationships between main researcher, assistants and the participants were respectfully and tactfully handled in order to curtail unintended influences on the outcomes. The research team was adequately trained in the areas of research ethics, main aim of the project, as well as interpersonal communication skills. Additionally, debriefing at the end of every strand of data collection, typically at the close of the day, was used to flag up any tendencies capable of negatively impacting the research outcome, which were then appropriately resolved.

4.9.1 Phases of the research processes and fieldwork data collection

The first phase which doubled as a reconnaissance exercise essentially was a rapid rural appraisal consisting of individual interviews with key persons armed with privileged information about the study communities about the patterns of land use, tenurial arrangements, area demography, general land management practices etc. The scoping exercise which occurred in May 2016 consisted of key informant in-depth interviews with the District Chief Executive of the study district, as well as the Deputy District coordinator, aimed at gaining broad understanding of socioeconomic development activities and challenges facing the people, especially as a 'young' district (created in 2012). Additionally, the Assembly members representing the six villages selected for the study were interviewed on broad issues confronting their individual communities. This stage was used to specifically gain community-entry and the best ways to implement the project processes, yielding insightful suggestions that were incorporated to perfect the processes for the main fieldwork data collection. The Assemblyman for Bussie for example, suggested that the main fieldwork could take place during the main cultivation period between March and June, which will enrich the project with firsthand farming experiences. Subsequently, all the in-depth interviews that occurred in March, highlighted a number of challenges facing agriculture in particular in the district, and how farmers had to resort to other non-agriculture alternative livelihood sources such as smock weaving, 'pito' brewing (a popular local liquor), shea butter extraction, blacksmithing, etc., to supplement household resources, during times of limited rainfall, which has been a common phenomenon in recent times (Samaddar et al., 2018).

The second phase consisted of the implementation of a survey questionnaire, designed based on the underlying research questions and insights obtained from the review of relevant literature as well as data from the scoping interviews, in sampled households. It captures information on key household characteristics, resource use patterns, farmland management and economics, views about tenure arrangements, trees, forests and savannah amongst others. Following a preliminary analysis of the survey data and critical questions that emerged from the second phase, a mixture of qualitative data collection methods such as in-depth interviews, focus group discussions, with key informants and some village leaders in the study communities, was used iteratively at the third phase to appropriately situate and provide depth to the survey data obtained (Nyantakyi-Frimpong and Bezner-Kerr, 2015; Creswell, 2013). Direct observations on people performing their daily activities in the home, farm and

marketplace afforded the researcher and his team the firsthand opportunity to probe into the exploitation and various uses of common NTFPs in the area.

It is useful to note that due to the scope of the research coupled with the researcher's consideration of completing the fieldwork in a time-bound manner, the hiring of research assistants was necessary. As a result, a total of four research assistants with a good working knowledge of the study communities were engaged to assist in the data collection exercise. In the selection of the research assistants, three main factors were considered: (1) their knowledge of the study communities, (2) educational and language background, and (3) previous experience of data collection either in the study villages or elsewhere. This was against the backdrop of the recognition that the chosen field personnel ought to have very good understanding of the context and capable of fluently translating English into Dagaare or Waali, the predominantly spoken dialects in the study area, and vice versa. Consequently, the recruited field assistants underwent training workshop led by the researcher, to thoroughly explain the focus and objectives of the project, and to assess their overall suitability for the exercise. In this light, when the researcher was fully convinced that the field assistants understood the objectives of the field exercise and were equal to the task at hand, then the team proceeded with the pilot survey. The pilot survey was crucial to this investigation and afforded the opportunity to test the survey questionnaire in terms of the appropriateness of the specific questions and quality of responses (Creswell, 2013), and see how field assistants approached the exercise first-hand.

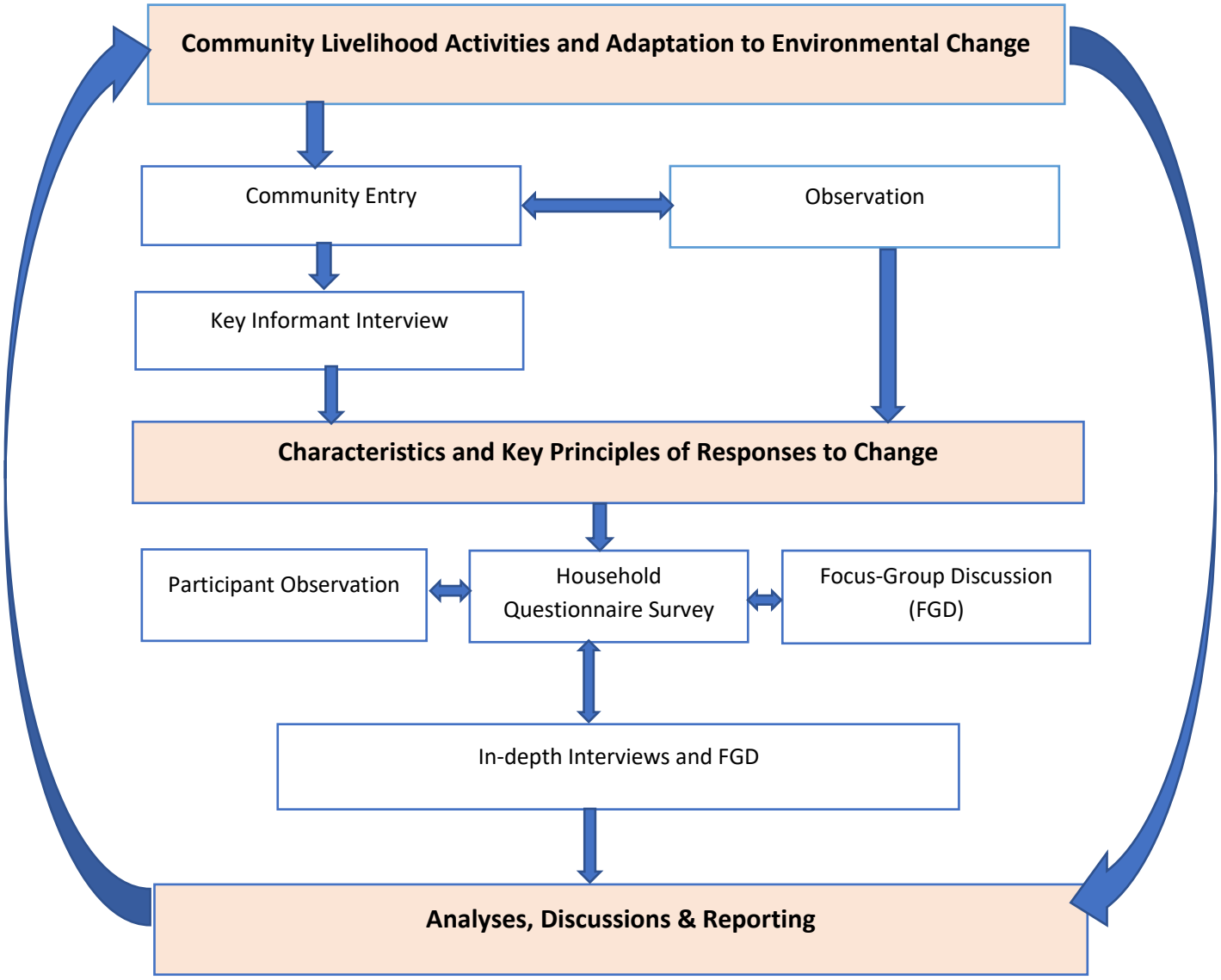


Figure 4.5: Fieldwork Data Collection Processes Workflow: Modified from Boafo, et al. (2016b).

The field surveys and in-depth interviews were carried out in six rural communities (Daffiama, Bussie, Fian, Issa, Kojokperi, and Tabiesi) in the Daffiama-Bussies-Issa District of the Upper West Region of Ghana. Specifically, various data collection techniques employed included initial key informant interviews (DCE, Deputy District Coordinator, MOFA, Wildlife officers, Teachers, NGO), household questionnaire survey, rural appraisal via focus groups, individual in-depth interviews, and direct observation (see Figure 4.5). These villages are climate change prone with rapid changes and increases in drought occurring in recent years. Transcribed data was organised into themes and sub-themes, while excerpts from interview and focus group discussions critical to the study questions were used to support quantitative data.

Region	*District*	*Study community*	*Location*	*Est. land area (KM^2)*	*Est. population*
Upper West Region	**Daffiama-Bussie-Issa**		$11^o30''$ N $3^o10''$ W	1,315.5 KM^2	32,827
		1. Daffiama	$10^o25'0''$ N $2^o34'0''$ W		3,519
		2. Bussie	$10^o28'60''$ N $2^o30'0''$ W		2,666
		3. Issa			1,609
		4. Fian	$10^o22'60''$ N $2^o28'60''$ W		1,220
		5. Tabiesi			2,311
		6. Kojokperi			2,977

Table 4.2: Geographical location, land area and estimated population of study sites

Figure. 4.6: Showing some of the characteristics of study sites, including dwellings, a mode of transport (tricycle), the only public pond in Kojokperi and a sample of dry season farming system near the only pond in the community.

4.9.2 Qualitative data collection techniques employed

4. 9.2.1 In-depth community/individual interviews and focus group discussions

Interview is perhaps the most commonly used data collection instrument in qualitative research (Punch, 2014; O'Leary, 2013; Denscombe, 2010). Punch (2014: 144) further suggests that "interview is a very good way of accessing people's perceptions, meanings, definitions of situation and construction of reality". In other words, an interview is based on the interviewee's own understanding or evaluation of a particular phenomenon as opposed to that of the interviewer. It mostly involves open-ended questions allowing for flexibility and adaptability to different research situations (ibid: 145). This study used a semi-structured approach to gather relevant data on dominant strategies to respond to social and environmental changes in the study area. Insights about land tenure security and household resource-use dynamics from institutional, individual and household respondents were also captured (see Figure 4.7). Choosing a semi-structured approach was informed by the fact that the research questions were pre-formulated subject to adjustment based on the emerging field data collection. It also provided the opportunity of flexibility in responses, as well as enabling cross-comparing of interviews (O'Leary, 2013; Berg, 2009).

The PhD project conducted five (5) individual in-depth interviews in Daffiama, the most populous community in the west part of the study district. Participants were selected randomly, but conscious effort was made to involve both women and men in order to capture a nuanced response from relevant segments of the community. An in-depth interview was conducted with the overlord (Landlord) of Daffiama. These interviews were followed by 3 focus groups involving the youth, men and women, necessary to capture differences of responses and opinions to enrich our understanding. Similarly, four (4) individual in-depth interviews, in-depth landlord interview, followed by 3 focus groups (youth, men and women), were all conducted in Kojokperi, the most populous village in the east part of the study district. A breakdown of the summary characteristics of the participants for the in-depth interviews and the focus group discussions in both Daffiama and Kojokperi are captured in Tables 4.3 and 4.4 respectively.

Table 4.3: Summary Characteristics of In-depth Interview Respondents

Categorisation	Kojokperi community (N=5)		Daffiama community (N=6)	
	Individual interviews (4)	Overlord interview (1) (Age=71)	Individual interviews (5)	Overlord interview (1) (Age=75)
Average age	40 years (4 interviewees)		50 years (5 interviewees)	
Household Size	15.7		12	
Predominant occupation	Farming		Farming	
Predominant religion	Islam		Christianity	
Common education level	Junior High School		Senior High School	

Source: Fieldwork, 2017.

Table 4.4: Summary Characteristics of Focus Group Discussion Participants

Categorisation	Kojokperi Community			Daffiama Community		
	Youth=7	Men=8	Women=7	Youth=7	Men=8	Women=6
Age distribution	23-30 years	32-65	20-60	21-28 years	30-58	24-61
Predominant occupation	Farming	Farming	Farming	Farming	Farming	Production and sale of local alcoholic beverage
Common education level	Junior High School	Primary School	No education	Senior High School	Primary School	No education

Source: Fieldwork, 2017.

The women in both communities were accompanied by a male sent by the elders but who did not contribute in the discussions. Reflecting on the effect the presence of the male had on the women, though all women participated considerably in the discussions, the researcher finds Daffiama women were much more vocal about issues that involved the attitude of men toward providing for household needs. A typical example is where the Daffiama women highlighted

the scenario whereby their husbands would prefer to purchase 'pito' from other sellers not minding the fact that they could have purchased from their wives for the money to stay within the family coffers to help in times of need. Overall, the discussions above signal the people's capacity to respond to climate change is influenced in one way another by the gender, religious affiliation and their location within the study area.

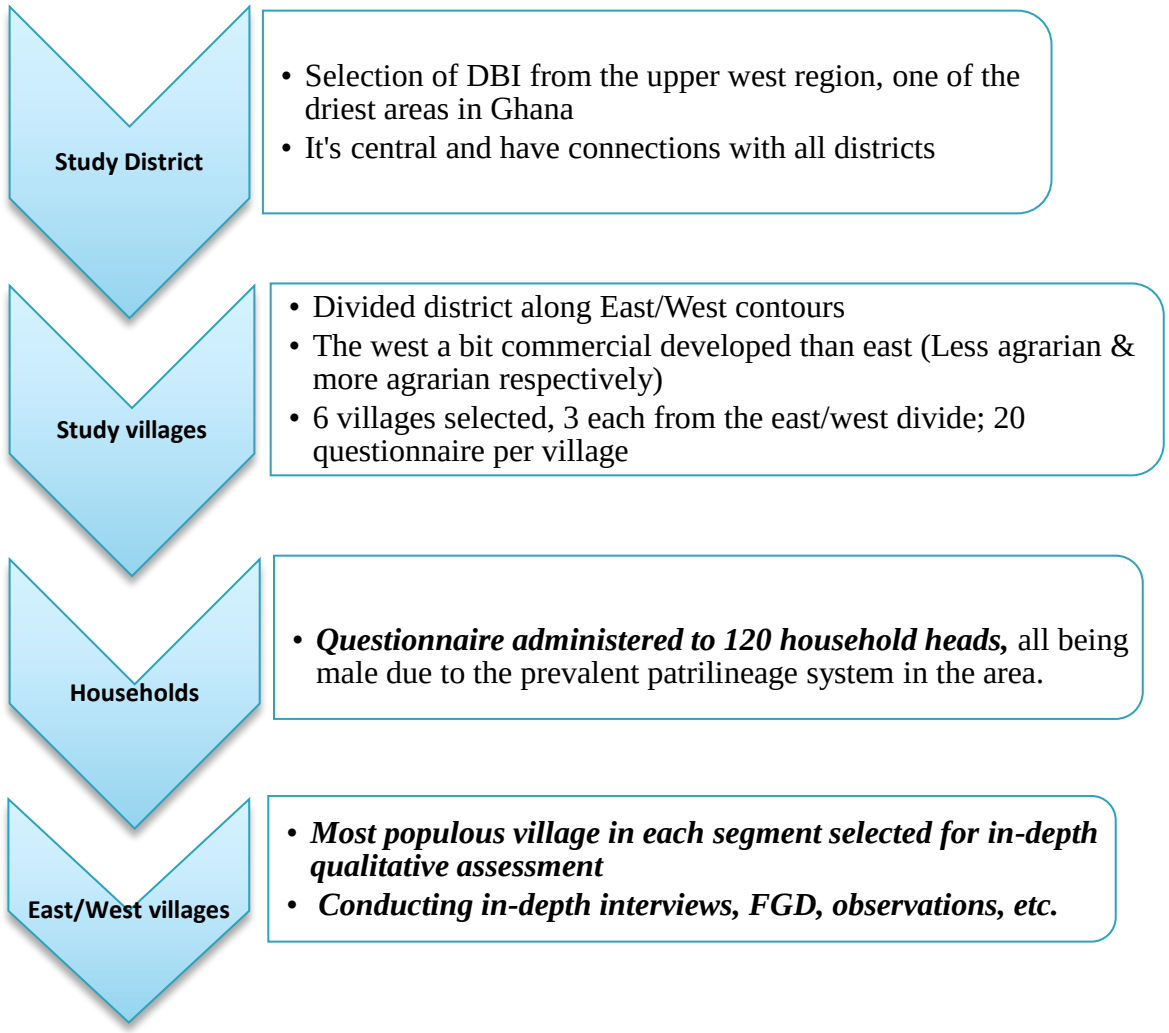


Figure 4.7: Data acquisition structure and plan.

Limitations of interviews as observed by several researchers are that they are often time consuming, difficult to code for analysis and highly prone to 'interviewer effect' (Denscombe, 2010: 193; O'Leary, 2013: 162-169; Punch, 2014: 151-152). Yet, interviews have been recognised to be mainly suitable in gaining in-depth information on a subject matter and exploring 'grey areas of research' (ibid). The information collected from the individual and group interviews complemented and enriched the depth of the survey data collected.

Consequently, identifying and gaining contact to respondents has been argued as crucial to conducting effective interviews (Punch, 2014; O'Leary, 2013). The manner prospective research participants are contacted and recruited have implications on almost all the stages of the research (Punch, 2014). This is particularly significant when conducting research in rural areas, including Northern Ghana, where access to relevant data could be problematic due to the socio-cultural arrangements. Although, it was relatively easier to contact most of the key informants identifies for this study (DCE, NGOs, etc,.) in their various offices, access to community and household-level respondents was carefully negotiated via identifiable opinion leaders. Subsequently, a reconnaissance survey undertaken in May 2016 served as a good opportunity for enabling access to the respective stakeholders identified in this study. This initial visit to the selected communities in the study area was beneficial in two main ways: Firstly, the exercise enabled the researcher identify and develop contacts with key informants; local opinion leaders, agricultural extension officials, government officials, NGO representatives and other researchers operating in the study areas. Secondly, the researcher was not only able to obtain first-hand information on the general farming and livelihood practices, challenges (see Figure 4.6) and confidence of stakeholders but also access to key documentary data.

Moreover, the researcher's in-depth knowledge of the local customs and traditions predominant in most rural Ghana akin to the study area was a significant benefit in negotiating access to key stakeholders throughout the initial field visit, and more useful during the main data collection phase. Indeed, this also proves useful in satisfying the criteria of 'theoretical sensitivity' in grounded research (Glaser, 1978). Therefore, the researcher being well aware of these traditional etiquettes in the study sites, offered customary gifts to the traditional authorities of the respective villages as part of the formal process of negotiating prior access to the start of the main data collection. Approaching the traditional heads in this manner signifies a formal acceptance into the communities and their approval to progress with the study. It also provided the platform to formally announce the purpose of the study and its consequent benefits to the community, thus, the need for their support in the entire exercise. Although much of the introductory aspects of data collection were accomplished during the initial visit, albeit, the researcher revisited most of them during the main field exercise. In line with institutional protocol and procedure, introduction letters (see Appendix 5) requesting permission to conduct interviews were submitted by the researcher to the respective institutional heads (mostly at the regional level) prior to the actual interviews with the district level representatives. In some

instances, verbal and or telephone explanation of the purpose of the research was sufficient in gaining access to institutional respondents.

Significantly, the interviewees and key informants who received attention represented different stakeholder groups (i.e., customary authorities, agro-environmental NGOs, agriculture extension officers, etc.) in the study district and sampled communities as mentioned above. These categories of respondents possess relevant local knowledge on land use dynamics as well as the sociocultural foundations in the study area deemed critical to the fulfilment of the study objectives and were therefore purposively selected. On the question of the actual interviewing style, which were conducted using guiding questions (see Appendix 2), the face-to-face approach was utilised in this study, with Twi (a major Ghanaian local language) and English translations into local dialects of Dagaare and Wali, being the approach of communication (Punch, 2014; Denscombe, 2010). The resulting interview data were mostly audio and video-recorded, all done with prior-informed consent from the interviewees (see Appendix 3). On average, the interviews lasted for about an hour and half to two hours as expected, and full consent from respondents was sort before interviews were audio taped on all occasions. Additionally, field notes were taken by the researcher for supplementary purpose of aiding triangulation with the other data sets in order to enrich and ensure data accuracy and reliability (Jensen and Laurie, 2016).

Moreover, the focus group discussion data collection instrument was used in the selected communities to obtain complementary information as well as serving as an avenue to triangulate collated data on some key research questions (Punch, 2014: 147). Denscombe (2010: 177) defines FGDs as entailing the gathering of small groups of people, usually with the researcher as the moderator, to explore attitudes and perceptions, feelings and ideas about a specific subject matter. FGDs are generally touted as inexpensive, data-rich, flexible, recall-aiding and elaborative and good at exploring issues that otherwise might not be exposed (Punch, 2014: 147). However, a main disadvantage of FGDs is that they are prone to problems of group culture and dynamics and achieving representative balance in a discussion could be challenging (Fontana and Frey, 1994). Using FGDs in this study was helpful in the areas of exploring the variations in the key issues understudy such as the contributions of women in household and community sustenance, as well as access to resources. Additionally, the FGDs were used as platforms to address any gaps and gather further data not earlier collected. Whereas the composition of FGDs remains diverse conditional to the research context and objectives, a maximum of six to nine people is generally recommended (Denscombe, 2010;

Punch, 2014). Accordingly, equipped with the above details of conducting FGDs, a checklist was developed and participants of the FGDs recruited using the snowball sampling technique, where prior respondents could suggest the next key informant to consult based on the significant contributions they can make to the study. Consequently, the FGD groups constituted of participants who were well-informed individuals on the items of discussion. Based on Denscombe's (2010:177) suggestion, "the core idea of FGDs is to constitute a number which is large enough to allow a range of views and opinions, but not too large to be unmanageable for a meaningful discussion", participants were limited to up to eight in each discussion group. Furthermore, to ensure a representative balance in the composition of homogenous FGDs, factors such as age, gender and communal membership status were given serious consideration, particularly the power differences that permeate societal arrangements in resource access and management regimes in the study area, to ensure that the groups were representative, practicable and also manageable.

In essence, the composition of FGD participants based on age, gender and communal membership status allowed for the differences in their diverse perceptions and experiences about changing conditions, security of tenure and general livelihood challenges to be captured and analysed. Proceedings were audio and video-taped with full consent from participants to supplement the continuous notetaking and still-photography by the researcher. Moreover, to ensure anonymity of interviewees in this study, the use of pseudonyms instead of real names and designations was strictly followed. The key informants in this study included staff of the Ministry of Agriculture, Forestry Commission, District Assembly, and village elders.

4.9.2.2 Participant observation

Participant observation as a data gathering method, has continued to receive various criticisms, especially of its predisposition to the subjective biases of researchers (Punch, 2014: 156). Yet, its usage in social research is still favoured (O'Leary, 2013: 170-177). Essentially, it is a systematic data collection process on the study subjects' actual behaviour (in this case farm households) relying largely on the researcher's 'emotive and sensory' ability as data collation tools (O'Leary, 2013: 170-171). The observational approach adopted in this research was mostly unstructured and had no pre-set criteria (see Punch, 2014: 155-157; O'Leary, 2013: 174). Subsequently, the researcher made every effort to continuously 'look and listen' to various exchanges of attention, taking down field notes for onward scrutiny and analysis to enrich other data collected. These exercises were useful for allowing the researcher to obtain

grounded information on the extent of the impacts of climate change, predominant livelihood activities, land tenure dynamics, prevalent cultural practices, etc., as guided by the research objectives and questions.

4.9.2.3 Documentary data

The data gathering techniques discussed earlier are all mainly for collecting primary data for analysis (i.e., interviews, FGDs and participant observation). However, documents, both historical and contemporary, are also noted to be rich sources of secondary data for social research (Punch, 2014: 158). As a result, documents formed a major source of data gathering in this study. Various government policy documents relevant to this study such as on agriculture, etc., were retrieved. Other relevant publications of some organisations such as NGOs operating in the study area were also accessed. The gathered documentary data enabled situating the study and triangulation of findings from the primary data. In the process of gathering relevant documentary, there is the need to be aware and constantly check for situations where information might be skewed, thus become misleading of the actual reality on the ground (O'Leary, 2013: 178). O'Leary clearly pointed out that "it may be tempting to treat the printed word as truth, but if you do, you need to ask whose truth?" (O'Leary, 2013:178). Collated documents were therefore carefully sorted out and checked against available empirical evidence, especially on the study area, in order to ensure any biases and flaws were effectively addressed.

4.9.3 Quantitative data collection technique employed

In this study, the survey process generated a total of 120 questionnaires, 20 administered in each research site. After the basic information section about respondents, proceeding sections of the questionnaire captured information on each of the seven key principles of building resilience (redundancy and diversity, connectivity, CAS, slow variables and feedbacks, learning, participation and polycentric governance) as discussed by Biggs et al. (2015). Guided by the study research questions and insights gained from the examination of the relevant literature, the survey questionnaire was designed to gather the quantitative data. The use of questionnaires is usually criticised as being unsuitable for studies that are designed to measure subjective characteristics about social phenomena such, as perceptions, feelings and experience

mainly because they employ closed-ended questions which have the tendency to mask relevant information (Denscombe, 2010). Consequently, the questionnaire for this study consisted mostly of open-ended but included some closed-ended questions (see Appendix 1). The closed-ended questions afford the measurement of respondents' experiences, insights, and ideas relevant to the research questions using the Likert scale as the main measuring instrument. Contrary, the open-ended questions allowed for detailed perspectives of participants responses (Denscombe, 2010: 165). The designed questionnaire was pre-tested in two villages prior to the actual survey as a way of judging its appropriateness in eliciting relevant responses to the questions posed. The pre-testing allowed for slight changes to be made to the questionnaire to enable respondents relate directly with it. Consequently, the questionnaire was structured into sub-sections basically to enable the gathering of detailed and quantitative data on household demography, assets, livelihood strategies, decision-making, household production dynamics, perceptions about land tenure security and documentation. The surveys were administered by the research team mostly in the homesteads of respondents or their preferred pre-arranged location.

Table 4.5 A tabular representation of the objectives, questions and methodology

Research Objectives (RO)	**Research Questions (RQ)**	**Methodology**
RO1: Identify and analyse key characteristics of the social-ecological system, such as the nature of the farming systems in the study area.	**RQ1:** How do households and communities respond to the impacts of environmental stresses?	• Survey analysis • Interviews • Observation • Documentary analysis.
RO2: Examine the dynamics of environmental changes and common responses adopted by people.	**RQ2:** what key principles underlie peoples' responses to environmental changes, and why?	• Survey analysis • Interviews • Observation
RO3: Investigate how resilience is understood and operationalised in the daily	**RQ3**: what evidence is there that these principles are ecologically relevant in building resilience?	• Survey analysis • Interviews • Observation

activities of the local communities.		


Figure 4.8: Researcher and assistant conducting focus group discussion session in study communities.

4.10 Data analysis and reporting

4.10.1 Analysis of qualitative data

The analyses of collected data highlight how short-term coping strategies transition into long-term adjustments thereby replenishing the adaptive capacity of individuals and communities (Brooks et al, 2005; Quinn et al., 2011), and what key principles underlie responses and choices. But, a plethora of techniques or approaches exist for analysing qualitative data (Punch, 2014; Miles et al. 2013; Denscombe, 2010). Within this purview, a long-standing controversy relating to qualitative research is the extent to which the approach to qualitative data analysis allows for reproducibility. Reflecting on this in conventional qualitative data analysis, the concept of 'audit trail' has been posited by some research methodologists as means of resolving this apparent analytical challenge (Punch, 2014: 170). The concept audit trail simply implies the sequencing of the stream of activities undertaken throughout the process of the qualitative data analysis. Accordingly, in a bid to simplify the usefulness of the analytical processes of the gathered qualitative data, this study followed Miles and Huberman's (1994) three-tier approach to qualitative data analysis. The approach fundamentally consists of three stream of analysis activities namely, (1) data reduction/condensation, (2) data display, and (3) conclusion drawing and verification.

The most populous village in each category was then selected for in-depth interviews, FGD, key stakeholder interviews, observations, etc. These were audio and video recorded with express prior permission from participants. The main aim of this segment of the project was to explore, reflect and analyse different aspects of the present conditions of the 2 villages as a representation of the district as a whole. Subjects examined included land tenure and land security, past social-ecological imbalances and challenges, their impacts, responses, as well as how present conditions affect individuals and communities, and how these compare to the past. Additionally, ways to improve present conditions in anticipation of recurrent future threats, thereby building resilience were examined. The interview and community FGD data in audio and video formats were transcribed using the Philips Voicetracer Audio Recorder DVT2710 (Dragon NaturallySpeaking, 2018) to convert the recording into a text file, which also involved typing out the field notes. The data analysis involved reading and examining the contents and identifying emerging themes for discussions. This process facilitated the categorisation of the information and the establishment of a thematic framework of ideas which responded to the research objectives and questions (Mahonya et al., 2019). The thematic analysis focused on exploring and recording recurring patterns in terms of the differences and similarities identified in responses. The key themes and issues resulting from the previous assessment were coded and categorised based on the theoretical framework, the research aim and research questions. Organising the data in themes and categories presents the potential of making prepositions and offering explanations to identified trends in the data (Creswell, 2013). An important aspect of the qualitative data analysis was the iterative process of continuous review of interview transcripts and the playback of audio recordings. This enabled new patterns to be identified and classified, while any contradictions within the data were appropriately addressed. See Table 4.6 below for an example of how corresponding responses were identified and categorised under themes and used to address the research objectives and questions. Regarding data display, this study generally embedded representative quotations from responses generated in the in-depth individual and key informants' interviews, and FGDs into passages to respond to the research questions. Accordingly, Table 4.6 below presents comments of respondents on the importance of irrigation as a crucial infrastructure development that will improve farming in the area, especially during the long dry season period where farming activities are almost halted due to lack of water.

Table 4.6: Example of extraction of emerging themes from interview and FGD data

Mention of irrigation as a means of improving farming in the community	**Response on other technologies and infrastructure**
"If there are irrigation with this dryland you can improve dry season farming and even prevent people from moving down south"	By building structures to ensure it acceptance
By practicing irrigation farming and cultivating dry resistant crops	New technologies should be introduced
Practicing other alternative ways of surviving eg. engaging in irrigational farming	By using tractors to plough
Applying irrigational farming	Using modern machinery and other equipment
By practicing irrigation system	New and improved infrastructures
Using irrigational system of farming	Through technology and training
By farming all years round through irrigation system	
Irrigation facilities should be provided	
Engaging in activities like irrigation	
By adopting to irrigation farming	
Practicing irrigation system of farming	
Using appropriate methods of farming eg, irrigation	

4.10.2 Quantitative data analysis

The survey data collection followed the east and west divide of the district, selecting the 3 populous villages from each zone for the administration of 20 questionnaires per village (120 questionnaires in total). This helped to collect baseline household data (where known), and to establish general conditions of the district as a whole (captured in Table 4.7), and to prepare the grounds for the in-depth qualitative interviews and focus group discussions (see Tables 4.3 and 4.4). The household survey data were coded using Microsoft Access Programme version 2011, then imported into the IBM's Statistical Package for Social Sciences (SPSS) version 20 to conduct descriptive statistics which generated frequencies, percentages (which were compared across categories), and the graph representations.

Table 4.7: Summary Characteristics of Survey Respondents

Categorisation		Daffiama (N=20)	Bussie (N=20)	Fian (N=20)	Issa (N=20)	Tabiesi (N=20)	Kojokperi (N=20)
Age distribution	20-35	3 (15%)	7 (35%)	11(55%)	5 (5%)	6 (30%)	3 (15%)
	35-60	7 (35%)	7 (35%)	4 (20%)	7 (35%)	4 (20%)	7 (35%)
	60+	5 (25%)	2 (10%)	2 (10%)	5 (25%)	1 (5%)	1 (5%)
Migrant	Male	2 (10%)	4 (20%)	2 (10%)	_	2 (10%)	1 (5%)
	Female	_	_	_	_	_	_
	Total	2 (10%)	4 (20%)	2 (10%)	_	2 (10%)	1 (5%)
Indigene	Male	16 (80%)	14(70%)	15(75%)	19(95%)	14(70%)	18(90%)
	Female	_	_	_	_	_	_
	Total	16 (80%)	14(70%)	15(75%)	19(95%)	14(70%)	18(90%)
Ave. HH Size		12	14.6	7.7	8	9	15.7

Source: Fieldwork, 2017.

4.11 Research limitations and ethical considerations

The issue of ethics has been raised as a very crucial pillar upon which the foundations of standards in empirical research is hinged and judged to have followed a properly executed social science research (Punch, 2014; Creswell, 2013). Jensen and Laurie (2016) suggest that research ethics helps to promote integrity, protect the welfare of others, builds support for one's research and gives directions when the research is faced with challenges in the field. In their view, researchers are expected to follow basic principles in research namely, to develop their competence level at all times, must maintain high standards of personal integrity throughout the research process- not using any dubious means or deception at any time (Jensen and Laurie, 2016). Furthermore, prior informed consent, confidentiality and anonymity are all ethical issues that must be considered carefully, and protocols complied with throughout the research process. Armed with these research methodological prerequisites and safety guidelines, the researcher took all precautionary measures, duly completed all stipulated documentation and secured the approval of the Open University's Research Ethics Committee based on their satisfaction that all necessary care has been taken to ensure the research was carried out in accordance with required standards as set out by the University (see Appendix 4). The approval was given prior to fieldwork, and all the documents were fully approved by researcher's

supervisors, Head of Geography department and the Postgraduate Director of the Faculty of Social Sciences.

4.12 Summary

This chapter has described the general methodological framework for the study, detailing out the research design and specific methods of data collection to be employed. Having given an overview of the research process the thesis will follow, it highlights the methodological considerations underlying the research, and then continues to elaborate on the research design and the justification of study sites selection for the study. This is followed by highlighting the data sources and sampling strategies adopted for both the qualitative and quantitative data collection. The report ends with the presentation on how qualitative and quantitative data collected were analysed to answer the research questions posed and to address the research objectives.

Chapter five

Provisioning ecosystem services and resilience: the role of non-timber forest products and cultural heritage attachment

5.1 Introduction

This chapter outlines the conceptual framework and uses empirical data to address the second and third research questions of this thesis. Specifically, the links between the Provisioning Ecosystems Services, especially the cultural services, non-timber forest products (NTFPs) and cultural heritage attachment are explored. The chapter examines the extent to which attachment to cultural heritage associated with NTFP exploitation influences people's choices of appropriate adaptation strategy to adopt. It is therefore imperative to align resilience interventions to what the community deems as culturally relevant to ensure that public acceptance could be garnered. This chapter addresses the three research questions (RQ1: How do households and communities respond to the impacts of environmental stresses? RQ2: What key principles underlie peoples' responses to environmental changes, and why? RQ3: What evidence is there that these principles are socially and ecologically relevant in building resilience, whilst remaining relevant to the local people?) of the thesis by exploring the evidence that cultural attachment is a socially and ecologically relevant principle to improve resilience via natural resource exploitation.

Drawing on household survey and qualitative data (in-depth qualitative interviews and FGD) complemented by secondary information (see Chapter 4), the study explores ways cultural heritage attachment as a principle, shapes NTFP use and its influence on the building of social-ecological resilience. This chapter demonstrates that socio-cultural processes underlying provisioning ecosystem services harvest and use have much stronger influence on resilience by governing peoples' decisions and choices. Thus, adaptation strategies could largely be affected by the extent of influence of culture and tradition. Gyasi and Awere (2018:291) for example found over fifty local adaptation strategies to climate change that were borne out of "traditional, local or indigenous knowledge", and this complemented scientific knowledge.

The significance of NTFPs in the livelihood of most local communities is huge and widely researched and documented (Saito et al., 2018; Jasaw et al., 2017). Products from a wide variety of NTFPs are used by both urban and rural populations to fulfil several livelihood requirements,

ranging from providing basic food needs, medicines, construction materials, and many others (Delgado et al., 2016). Between 1.4 -1.6 billion people are estimated worldwide by the FAO (Adam, 2017; FAO, 2001) to make use of NTFPs in one form or another. Several of these products perform multiple functions, whilst interconnecting with many other ecological materials and significantly affecting the social and cultural lives of local communities who are the main users. However, the aim of expanding the source and base of natural resources such as NTFPs to mitigate against the impact of climate change, reduce poverty and improve livelihoods in local economies often clashes with local cultural norms or objects, which in themselves have become resources that closely connect with every other resource within their catchment and cannot be overlooked. Cultural and religious values are attached to ecosystem services (ES), and particularly cultural ecosystem services (CES) (Jasaw et al., 2017; Chapin, 2009). This chapter therefore seeks to deepen understanding on how to appropriate the interdependencies between culture and resource management in ways that can improve the resilience of the community to respond to change. The study applies the theoretical standpoint of ES use as noted earlier, focusing on the often neglected area in the literature of the interactions between provisioning services and cultural services (Chapin, 2009) that play key roles in how a community build resilience through the management of its natural resources (see Figure 5.1).

Evaluating and valuing the use and significance of NTFP requires a holistic approach that considers the multiple products in connection with the multiple livelihoods functions they perform, and especially, within the context in which they exist (Hadish, 2018). The connection of local communities to NTFPs especially, relying on wild products as part of their mainstream livelihood support system has a long history behind it even from the hunter-gatherer era of human existence (Cooper et al., 2018). The practice has grown to be adopted as alternative sources of food and income for the local people in times of stress in the structures that provide them with their needs (Delgado et al., 2016). There have been calls to expand, revive and restore the dwindling base of the products as a result of severe impacts of climate change which has continued to affect vulnerable local communities living along forest and savannah woodland fringes (Ahenkan and Boon, 2010). Most practitioners and scientists have continued to advocate for the commercialisation of NTFPs to serve as alternative sources of employment and income for local forest dwellers in the face of debilitating farming conditions resulting from climate change (Boafo et al., 2016a).

However, the successful implementation of any strategy to reinvigorate the sources and to boost the supply of NTFPs to support local economies must be approached in a holistic perspective whereby the implications of the contextual dynamics within which people conduct their daily activities are taken into consideration (Hadish, 2018). Subsequently, incorporating social contextual attributes such as cultural, belief and emotional dimensions of environmental change into understanding how society deals with, and shapes anticipated transformation has a crucial impact in environmental change management debates (Brown et al., 2019). This chapter therefore, explores and argues that the aspect of looking at NTFPs including wild plant and animal species, as a common part of local community natural resource base, dating long back in the history of local communities, and providing the basis for their identity and cultural attachment, must be critically understood and applied. Thus, not just to look at NTFPs through the lens of the ecosystems provisioning conceptualisation of alternative source of living for the people, which has continued to gain popularity in research and practise (Hadish, 2018; Shackleton and Pandey, 2013; FAO, 1999). But that the local context in the form of culture, traditions and belief systems of the people have considerable implications on the significant value of NTFPs to rural dwellers in particular and must be recognised and examined.

As earlier highlighted, the central focus of this chapter was to understand the subtle interplay of culture and ecological interactions by specifically examining the significant contribution of NTFPs to rural livelihoods and the influence of the notion of cultural attachment, especially as it relates to the building of resilience to climate change. To achieve this goal, three sub questions guided the empirical examination of the chapter: What key NTFPs exist in the area and what are the perceived importance of these to livelihood? What are the current levels of availability, and potential constraints of accessibility of these NTFPs? Does the principle of cultural heritage attachment have implications on the exploitation and expansion of NTFPs, and the enhancing of resilience of dryland SES? One of the key principles the study found is relating to cultural attachment of families to some specific NTFP items, and how this can influence and determine the extent to which communities would accept and support climate adaptation strategies that are in conflict with their cultural beliefs and values. Ideas such as family heritage, respect, bravery, symbol, prestige, etc, may all be considered under the notion of cultural attachment and their subsequent influence in choices and decisions involving natural resources (Chapin et al., 2009). Arizpe et al (1998) contend that sustainability of natural resources must not only centre on the bulk of the resource but rather on the use to which the people subject the resource, which has a greater traction on the way societies are affected. It is

against this backdrop therefore that the cultural heritage underpinnings of how society chooses to utilise NTFPs to meet its needs now and in the future becomes a crucial element of study. Additionally, the study is important in order to understand the role of cultural attachment as a phenomenon that influences climate change strategies and for that matter the building of resilience of social-ecological system to climate change. The next section provides a brief background and discussion on NTFPs and the theoretical framework guiding the research questions before delving into the emerging empirical findings from this part of the thesis.

5.2 Non-timber forest product exploitation and use

Record on the significance of NTFPs to poverty alleviation in rural communities seems to be missing in the economic measures of such areas, despite its contributions estimated to far outweigh even timber production in Ghana for example (Ghana Forestry Commission, 2012). Many dwellers in the northern savanna regions of Ghana where this study was conducted depend on NTFPs as alternative source of livelihood provision due to limited options (Issaka, 2018; Cooper et al., 2018), but NTFPs have not assumed prominence in national and global policy arena (Issaka, 2018). The incidence of poverty is highest in the Upper West Region where about 71% of the population is considered poor (Ghana Living Standards Survey, 2014). Agriculture is the main- stay of the rural economy of the people in the study area, but considerable numbers of households are collecting and processing NTFPs for consumption and sale as the market for its products is growing. Some of the major NTFPs exploited in the Northern Ghana including the Upper West region include shea nuts, baobab leaves and pods, and game animals (Issaka, 2018).

Rural communities make extensive use of various NTFPs for subsistence and income in northern Ghana (Chiotha et al., 2018; Issaka, 2018), but the range differs between households and communities as a result of contextual factors of availability and resource endowment. One or more household members engage in economic exploitation of NTFPs, but women form the majority of this number. NTFPs account for low proportions of annual household income, about 10% according to Issaka (2018). Possible reasons could be the low value associated with NTFPs and most NTFPs are sold at the farm gates to middlemen who rather derive much more profit from the exploitation and sale of the products than the actual households involved. For example, shea nuts (*Vitellaria paradoxa*) sold to intermediaries at the farm gate is purported to

yield over 300% for these middlemen to the detriment of actual beneficiaries from the communities (Issaka, 2018). NTFPs are either sold raw or processed normally in the informal or local markets and regional markets. However, some may reach high value international markets (Hadish, 2018; Ahenkan, and Boon, 2010). Most popular and commonly used NTFPs are fuelwood, wild foods, building materials and medicine. Modern medicine is normally difficult to access by local communities and most often unaffordable. But, traditional medicine is normally readily available and mostly free to access. Herbal treatments are generally administered by herbal medicine practitioners also known as faith healers.

Cultural identity and cultural heritage are strong components of ES that influence people's sense of stewardship towards the environment, and especially how natural resources are harnessed for the common good of the society (Chapin et al., 2009). These areas present excellent opportunities for environmental managers, and especially external actors to learn from and contribute to stakeholder efforts towards sustaining livelihoods and the environment. Cultural heritage in the form of stories, legends, memories, etc, are great ways of informing the development of viable strategies that work in the best interest of the local people, not alienating them, but rather fostering their cultural identity (Chapin et al., 2009). Activities that align themselves in ways that enhance attributes of cultural heritage of a people therefore have better prospects of gaining the trust and support of the local people. Though NTFPs exploitation falls directly under provisioning ES, they also carry characteristics within the cultural ES suite where cultural identity and heritage play key roles in mediating people's sense of belonging and therefore must be understood, interpreted and incorporated into climate change mitigation strategies. Cultural services, though non-material, could easily be overlooked, but are very crucial for the long-term sustenance of ES. They ensure that most provisioning services that are fundamental to the livelihood systems of local communities and the general well-being of society such as food and fresh water, are maintained over long periods of existence. Cultural values usually mobilise support for sustainable management of ES (Chapin, 2009), propagating essential ecological knowledge to successive generation through traditional ecological knowledge (Boafo et al., 2016b), and institution of rules regulations and sanctions through local governance systems (Biggs et al., 2015), are all ways culture and traditional practices help to maintain ecosystem functioning and sustenance.

5.3 Theoretical and conceptual framework

This section sets out the theoretical considerations upon which the data on the exploitation and use of NTFPs is analysed to show its benefits for improving the lives of the local people, whilst

contributing to the resilience of their SES against climate change. The link between the Ecosystems Services theory and NTFPs is explored in order to situate the role of NTFPs in the lives of the local communities, and to specifically highlight the implications of cultural services ecosystems services and the building of social-ecological resilience via the principle of cultural heritage attachment.

5.3.1 Ecosystem theory and the definition of non-timber forest products in context

The term ecosystem has been generally used in the ecological literature to refer to the ecological system of plants and animals as well as non-living matter, and their general interactions with the environment in which they exist. It is the things these interactions produce for human benefit that are called ecosystem services. The Millennium Ecosystem Assessment (MEA, 2005) has therefore defined ES as the benefits the people receive from ecosystems, which they divided into four categories; provisioning, regulating, cultural and supporting services (Figure. 5.1 & Table 5.1). The supporting services are identified to form the foundations of the other ecosystem services. The provisioning services and the cultural services for example are significant sources of benefits to local forest dependent communities. Thus, this study explores the interconnections between ES and argues the case for the important role the principle of cultural identity and heritage plays in natural resource management decisions at the local level.

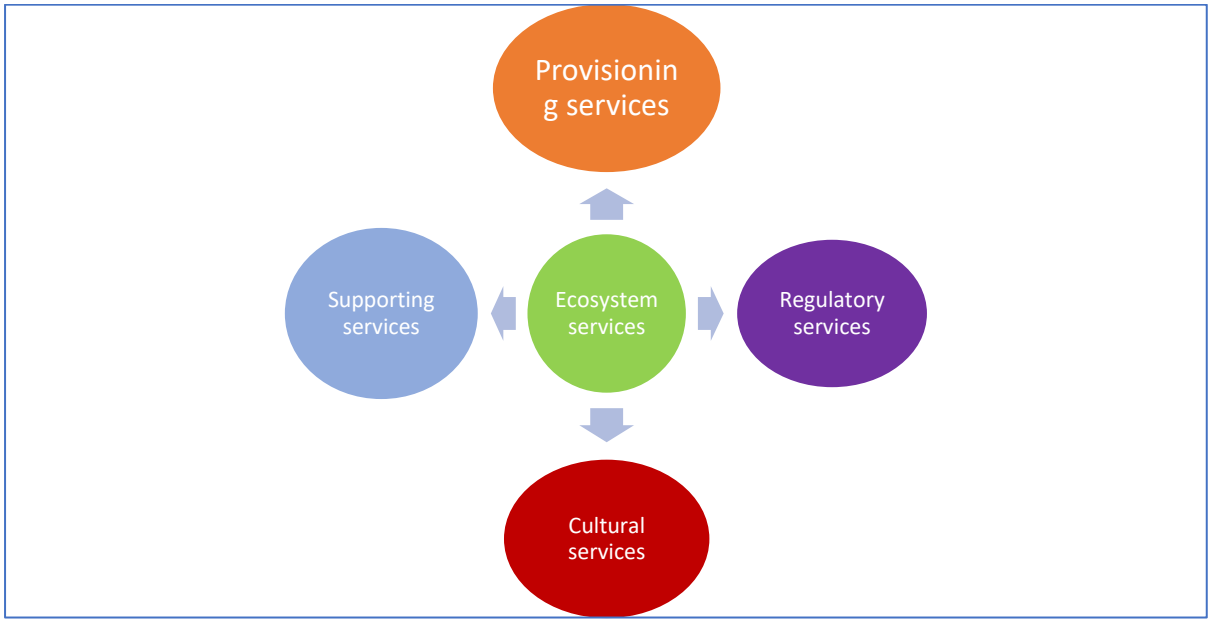


Figure 5.1: Categories of Ecosystem services, adopted and modified from Chapin (2009:30).

Table 5.1 Ecosystem services, examples and benefits:

Ecosystem service	Examples	Benefits
Supporting services	Maintenance of soil, water cycle, Carbon and nutrient cycles, maintaining biodiversity.	Nutrition, health, shelter, waste management.
Regulating services	Climate regulation, water quantity and quality, disease control, erosion, pollination.	Safety, health, nutrition, waste management
Provisioning services	Food, fuelwood, water, fibre, biochemicals, genetic resources.	Nutrition, health, shelter, warmth, safety, waste management, cultural integrity.
Cultural services	Cultural identity and cultural heritage, spiritual, inspirational and aesthetic benefits, recreational and ecotourism.	Cultural integrity, values, health.

5.3.2 Provisioning ecosystem services and cultural services (CS)

The earth system is constantly changing and these changes are highly connected, involving the physical, ecological and social processes (Chapin et al., 2009). It is necessary therefore to understand current and future ecosystem change requirements through an interdisciplinary holistic perspective.

5.3.2.1 Defining non-timber forest products

NTFPs are one of the oldest traded commodities and have historical importance to local communities especially. They refer to any product or service obtained from the forest other than timber (Likoswe et al., 2018). However, its definition is seriously under debate (Ahenkan and Boon, 2011) as a result of the complexity of the characteristics of forests and forest

products. But what is common among the variety of definitions is the fact that NTFPs are extracted from the forest, excluding timber. They are collected from a wide variety of ecotypes, including the savanna woodlands and the products include fruit and nuts, vegetables, fish and wild game animals, medical plants, resins, essences and a range of barks and fibres such as bamboo, rattans, and a host of other palms and grasses (Issaka, 2018). NTFPs could be viewed as an expression of traditional knowledge and in cultural terms, as explored by Shackleton et al. (2018). The FAO in 1995 introduced the term NWFPs (Non-Wood Forest Products) which they classified to represent all goods of biological origin other than wood derived from the forest, other wooded land and outside the forest (FAO, 1999). The implication of this definition was that NWFPs consisted of both animal and plant species, but strictly excluding woody raw materials. Issaka, (2018) on the other hand, in his study of the significance of NTFPs in climate change resilience and poverty alleviation in rural communities in northern Ghana, adopted a definition of NTFPs that consisted of only plant material sources. Though plant materials are the products exploited in significant quantities than other products, this study expanded on the scope of this definition to include some animal products such as wild game, which is an important part of community living in the study area. In fact, the examination of wild game hunting as a traditional and cultural heritage attachment phenomenon forms the overarching purpose of this chapter. Insights from how cultural heritage influences people's actions and decisions inform how climate change adaptation strategies must be design and implemented to win public support, which ensures the long-term aspects of the strategies to build resilience. Therefore, all biological matter of wild plants such as fruits and nuts were included in the study but excluding products from non-native sources and privately cultivated outside savannah woodlands. Wild animal products were however added to expand the scope of products under investigation.

NTFPs are currently seen as a key alternative strategy to support local communities to cope and respond to the impacts of climate change. They may be the fall back in times of emergency, serves as means of providing diversification to local systems and to fulfil community livelihood requirements (Hadish, 2018). Consequently, there has been a massive drive by international organisation such as the FAO to boost and increase the stocks and use of NTFPs via commercialisation and the value chain models to provide alternative income sources for local communities in the bid to alleviate poverty. This is meant to alleviate poverty in local communities by creating and increasing employment opportunities, income sources and food availability (Issaka, 2018). Ahenkan and Boon (2010) further stressed that commercialisation

of NTFPs when done properly will provide an important means for poverty reduction in local communities, as well as food security, nutrition and the sustainable management of forest resources. But, the missing link for sustainable management of resources and building of social-ecological resilience is the cultural value individuals and communities attach to the processes as well as the significance of collection of wild products which dates back centuries in their history. But, this popular notion among the resilience and development literature of wild products as just alternative income source, especially in times of stress (Delgado et al., 2016), if left to persist could inadvertently alienate local communities of their sense of cultural identity to prepare and respond to change, and could erode their capacity to embrace and implement relevant local strategies to improve conditions and respond to climate change. Interdisciplinary analysis is yet to fully understand the underpinning principles and phenomena that drive global environmental change, though there is wide acceptance of the role of social and economic structures as drivers of environmental change (Brown et al., 2019). This chapter, however, tries to explore the interconnections between NTFP exploitation, cultural ecosystem services and the building of social-ecological resilience, in order to increase understanding of the implications of embedding this cultural and historical attachment principle within the many measures to improve the capacity of communities to respond to change and changing conditions through the production and commercialisation of NTFPs. Underappreciation of the implications of cultural and traditional contexts within which NTFPs and human interact may affects sustainable exploitation and use of the products, and most especially, may result in considerable social cost.

5.3.3 Linking cultural heritage attachment and non-timber forest products and resilience

People's cultural connections to the environment could be looked at from the angle of current cultural connections (identity) as well as their cultural heritage (memories of past cultural ties to the environment, in Chapin et al., 2009:344), and these cultural underpinnings play considerable roles in the choices and climate change strategies they adopt. Consequently, the ecological and sociocultural components of NTFPs are key areas of research in order to untangle the role cultural symbolism (relating to the transmission of behaviour and traditions from one generation to another) plays in NTFP extraction and use, and the implications for adaptation strategies that build resilience or restricts it (Shackleton et al., 2018).

It is also significant to analyse the 'context' within which NTFPs exist and the linkages that emerge as a result of prevailing culture of the surrounding communities (Hadish, 2018). Cooper

et al. (2018) for example established in their study of four African countries that contextual factors such as geographical location, land cover type (and for that matter the availability) and population density were significant predictors of whether a household will report collecting NTFP than household characteristics such as household income levels. Thus, insights of the sociocultural contexts surrounding the harvesting and utilisation of NTFPs can offer ways to positively involve local communities in strategies designed to improve the resilience of their SES in order to increase participation and acceptance for the long-term success. Furthermore, borrowing from the concept of cultural ecology which refers to the field that studies the relationship between the natural environment and culture (Chapin et al., 2009), various aspects of a community's cultural fundamentals relate and influence how natural resources in the form of NTFPs especially, are appropriated and utilised. Apparently, within the arena of natural resource, culture and other contextual antecedents, certain privileges and values can be restricted or denied by mainstream science and development strategies thereby leading to the concept of social cost to an individual or community (De Groot and Schuitema, 2012). However, cultural identity seems to be the widely connected component, but easily misrepresented and, or left out completely from the natural resource management discourses.

5.3.4 Social cost, identity and empathy

The concept of social cost refers to restrictions on existing daily activities that individuals perceive might arise from the implementation of policies (Jones and Clark, 2013) and which cannot be readily measured in monetary terms. Some of the perceived social costs that communities may link to include the following:

- Loss of identity
- Delineation from cultural heritage
- Loss of alternative sources of food and income
- Loss of authority and or ownership of land and other natural resources (thus, the need to establish 'unconditional' trust from the outset).

In contrast, some of the social benefits of developing and implementing policies may include:

- Enhanced biodiversity
- Protect against erosion and other natural hazards
- Improved environmental quality
- Providing low costs to, for example seas defences in 'soft' approaches rather than strong defences.

Most recent studies have extensively examined the social benefits end and have advocated for more work and application (Chapin et al., 2009). But these studies seem to have ignored examining the significance of the social cost aspects associated with the introduction of adaptation strategies to respond to climate change, especially those cost that are likely to undermine cultural heritage and identity of local communities (Jones and Clark, 2013). People view the greatest constraints and for that matter greatest social costs, as those policy changes that impose or require a significant change of their activities or behaviour (DeGroot and Schnitema, 2012). Perceived lower social cost is where citizens are familiar with new policy which may just be introduced to complement existing measures. We should note also that perceptions about social costs and benefits may continue to change in the lifetime of policies and must be revisited periodically to make necessary adjustments. Social costs decrease with increased use or familiarity (Andriani, 2013).

Therefore, issues of social costs and benefits must be crucially engaged with in formulation of locally appropriate strategies of climate mitigation, and especially in the implementation phase. Social capital is generally regarded to have influence on civic engagement of local communities and adaptation levels. Attention must be shifted on the noneconomic social costs and benefits, incorporating them into strategies. Cultural identity is one of such crucial examinations to embark on at the outset of climate change mitigation and improving resilience of ecosystems, ensuring that local communities are not alienated from their identity through the modernisation and commercialisation of most of the NTFPs that constitute major part of their usual activities when cultural principles are not taken into account.

Identity fashioned by tradition and culture underpins people's perception and acceptance of change and interventions. Place and identity have the tendency to foster social and spatial exclusion as well as inclusion (Fried, 2000). Place has important implications for human response to and efforts to shape environmental change. Place involves processes of generating meaning, emotional attachment, and embodied engagement in particular environments (Haluza-DeLay, 2014). Places are highly dynamic, and people's attachment and engagement with place (such as ownership to land and trees) offers possibilities of whether and how they respond and shape environmental change. Any actions and or inactions that suggest an attempt to delimit local people's background could lead to loss of place as a result of the likelihood of being alienated from one's cultural identity and may largely motivate resistance to change (Boafo et al., 2016b). But, the concept of empathy, which involves the process of perception taking and emotional connection, seems to provide the precursor for sustainable interaction

with the biosphere. It reconnects humans and the environment, and sometimes provides the motivation for pro-environmental behaviour and actions. Empathy with nature is the capacity to share the emotional experience of the natural world. An example is the cognitive capacity to understand distress of an animal that is suffering the consequence of its polluted environment (Haluza-DeLay, 2014).

Brown et al. (2019) therefore describe empathy as the means of taking the perspective of the other (both plants and animals) and feeling an emotional bond with the other. Empathy therefore could be seen as having strong influence on how society through culture address the components of nature. This could largely be in terms of the experiences one goes through, and or, the understanding we have towards another. Such attributes of human interactions embedded within specific cultural principles require careful disentangling in order to be able to account for their influence on people's choices and behaviour. Consequently, the nature of various environmental change interventions may largely end up alienating people from the direct experiences of nature. But, people's emotional attachment to nature has direct implications for sustainability (Brown, 2014). Cultural and emotional attachment to a place and the extent to which this place is shaped by emotions is a critical element of how people respond to the place and nature. Relationship between empathy and sustainability represents a key advance in understanding underpinning human-environment relations. Brown et al. (2019) assert that lack of empathy for nature and others limits and or, affects motivation to conserve the environment and enhance sustainability. Thus, mediation of place and identity is critical in the relationship between empathy and sustainability which is the ultimate focus of this thesis by understanding underlying principles that inform decisions and choices and by extension, acceptance or rejection of resilience strategies. The data collect, the methods used and the analysis follow in the next sections.

5.4 Data and methods of data collection

As discussed in chapter four, this study broadly applies a qualitative research methodology under an interpretive paradigm to explore context-specific principles and critical factors that improve adaptive capacity and the building of social-ecological resilience in coupled Social-Ecological Systems. The project adopts an exploratory case-study design and employs a mixed method data collection approach. The following steps show the process of data collection as

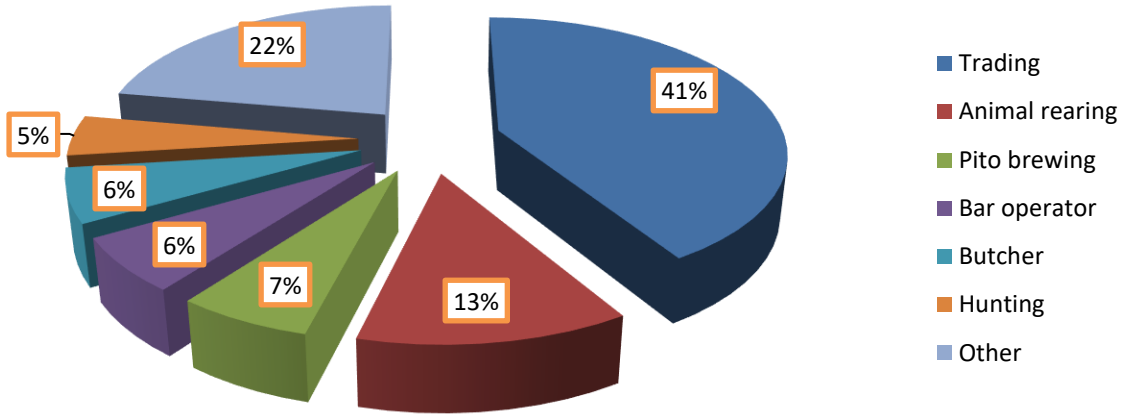
captured in Figure 4.6. The Daffiama-Bussie-Issa district in the Upper West region of Ghana (one of the driest parts) was selected for the thesis based on its central position within the region, sharing boundaries with almost all the other districts, which makes it an interesting case to understand the impact of interactions and feedbacks from the other regions. It also serves as the 'bread basket' of the region, whilst being a recent district created in 2012. Although DBI is predominantly a farming community, there are few marked differences between the east and west corridors of the district. The east bounding the Gbele Game Reserve provides conducive micro-climate for agriculture, thus the inhabitants engage predominantly in food crop farming (see Figure 4.1). It is also predominantly Muslim and less developed compared to the largely Christian west which is more commercially developed. Subsequently, the researcher divided the district into two regions (east and west) and selected the 3 most populous villages from each zone resulting in 6 villages in total. The research team then administered 20 questionnaires in each village (120 questionnaires in total) to collect baseline household data, and to establish general conditions of the district as a whole, and to prepare the grounds for the in-depth qualitative interviews and focus group discussions.

Due to paucity of data in the study area, and especially the lack of statistical data, the snowballing technique which is a non-probabilistic sampling method was largely used to recruit participants for the key informant interviews (Abdul-Razak and Kruse, 2017). The study started off by contacting community 'assembly members' who are the representatives of the people in the local assembly, as community entry in an initial field visit in May 2016. This group then introduced the project to the Chiefs and elders for their consent during the main data collection which lasted for eight weeks, in addition to two weeks initial field visit. The Assembly Members also helped in listing various households in their respective villages, where households were randomly selected and household heads (HH) interviewed as the main target group. To gain 'informed consent', each participant was thoroughly briefed on their right of declining, and anonymising of information to protect their privacy and protection. Subsequently, the most populous village in each category was then selected for in-depth interviews, FGD, key stakeholder interviews, observations, etc. These were audio and video recorded with express prior permission from participants. The main aim of this segment of the project was to explore, reflect and analyse different aspects of the present conditions of the two villages as a reflection of the district as a whole. Subjects examined include the dynamics of NTFPs and the building of resilience, past social-ecological challenges, responses and the influence of the principle of cultural heritage attachment.

5.5 Results and discussion

In line with the objectives and the research questions of this thesis (see chapter one), households' usage of NTFPs were queried and the results showed that 97% of the respondents indicated NTFP use in the areas (Table 5.2). Three main sub-headings, namely (1) popular NTFPs and their perceived significance in the area; (2) availability and accessibility of these NTFPs; and (3) the implications of cultural heritage and expansion of NTFP, which explores the question of understanding underlying cultural principles that dictate how people make choices and decisions either to support or reject or sometimes sabotage resilience strategies are presented. This chapter has specifically addressed the extent to which cultural heritage attachment to NTFP exploitation underlies people's decisions and climate change adaptation strategies consistent with resolving the research questions of this thesis. Regarding the dynamics surrounding NTFPs within the entire study area, the eastern communities like Kojokperi were largely concerned with obtaining access to the Gbele Game Reserve to exploit the resources. This was as expected due to their proximity to the reserve and their cultural orientation to natural resources as received through their parents and tradition. Conversely, the western communities around Daffiama, consistent with their distance away from the reserve (see Figure 4.1), were worried by the variability and dwindling nature of NTFPs over the years. They stressed the wish to have available water sources like dams and irrigation facilities for the cultivation of vegetables and other crops especially during the dry seasons, which have continued to increase in severity. Women were generally concerned with being able to provide food and other basic needs of their households no matter which part of the district they are located. As a result, they joined men to engage in other economic activities outside of the usual farming (see Figure 5.2).

Fig. 5.2: Household economic activity apart from farming



Source: Fieldwork, 2017.

Women's role in household management and sustenance in the study area has long been recognised. They ensure children are well catered for in terms of feeding and are able to attend school when the means permit. They engage in petty trading and are the sole participants in pito brewing (see Figure 5.2) which is a recognised income generating alternative for families over the years. As echoed by this interviewee below, women's support to society is heightened in critical times:

The contribution of women to society is very crucial because they manage in critical periods (D_INTV_1).

From the above discussions, resilience interventions must account for women's contributions to household resources capacity and develop measures to invigorate their foundations. As women are largely associated with access to, and utilisation of NTFPs for household provisions, this makes NTFPs a significant resource in the arsenal of families to respond to climate change.

5.5.1 Significance of popular non-timber forest products

This sub-section discusses some of the dynamics surrounding the usage, sale, access issues and broad desire for forest protection and conservation.

Table 5.2: Dynamics of non-timber forest products utilisation in the study area

Response	NTFP Usage (%)	NTFP sale (%)	Restrictions of access to NTFPs	Protecting Savannah/forest & NTFPs
Yes	116 (97%)	110 (92%)	43 (36%)	119 (99%)
No	1 (1%)	7 (6%)	73 (61%)	1 (1%)
Unanswered	3 (2%)	3 (2%)	4 (3%)	_
Total	120	120	120	120

Source: Field survey (2017)

The results show that almost all respondents (97%) have used and continue to use NTFPs in one form or another to fulfil their household needs (see Table 5.2). This is reinforced by answers to a follow up question which was used to check the significance level of products from the natural environment to the people's livelihoods. Ninety-two (92) percent of the respondents actually confirmed that they either obtain the products for direct household use especially in times of resources stress to meet their needs, or sell some of the products e.g., bushmeat to provide alternative income to meet other needs such as medical bills (see Table 5.2). Thus, obtaining NTFPs from the forest is likely to improve their capacity to cope with changing conditions in the future.

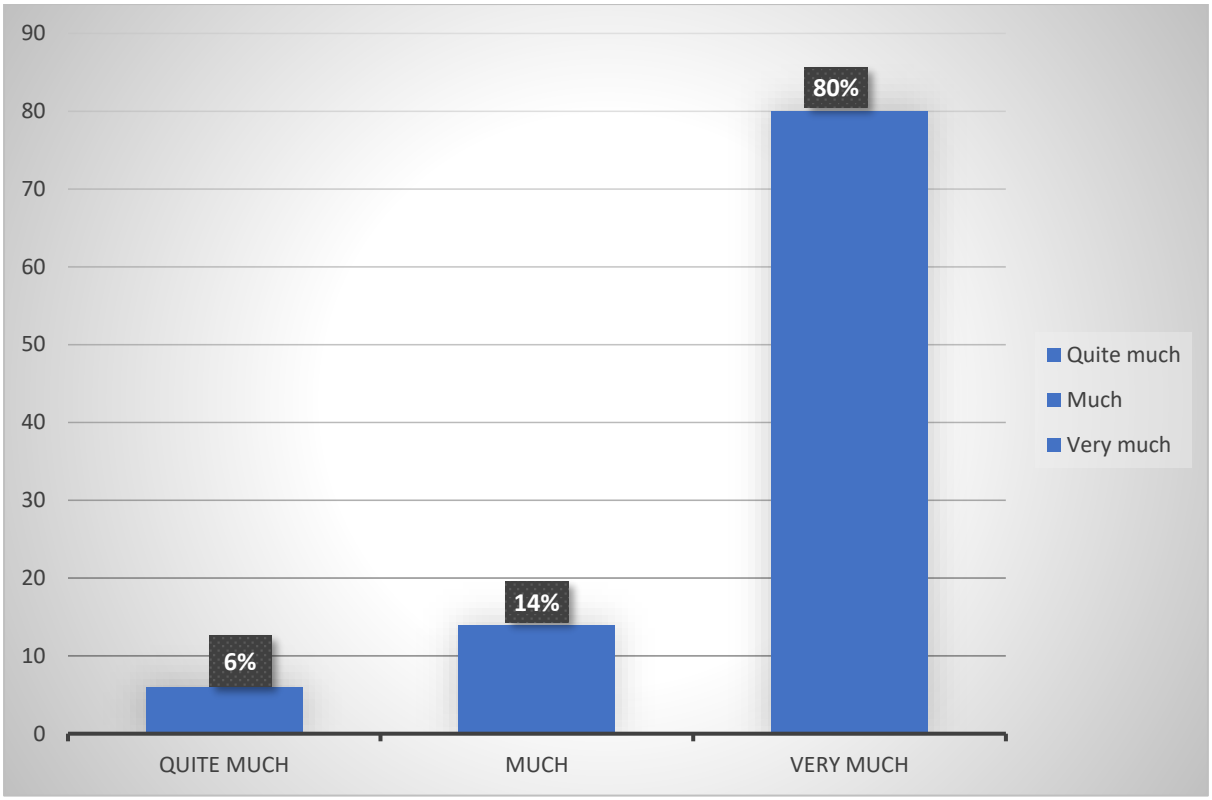


Figure. 5.3: Level of household dependence on the environment and NTFPs

Figure 5.3 shows a significant percentage of households surveyed depend and use environmental resources by exploiting NTFPs (80%) to support their livelihood and build resilience via increasing their capacity to adapt to and mitigate change. With such knowledge, it is important to institute conservation measures to protect the forests and savannah ecotones, as well as increasing the ways to improve resilience of their SES to climate change. Nevertheless, it is people's social and cultural connections to the natural environment that govern the exploitation and use of NTFPs because of their spirituality and reverence for natural objects like trees and hills (Chapin et al., 2009). It is against this backdrop that this thesis stresses the need to unpack any underlying principle of people's decisions and choices with the likelihood of mediating acceptance, support and or stewardship of resilience projects (Cooper et al., 2018; Boafo et al., 2016a). Knowledge of these principles could help to obtain the vitally important local community support for the successful implementation of resilience interventions. Missing such support could jeopardise the long-term benefits expected from resilience projects.

Table 5.3: Major NTFPs in the area (Modified from Boafo et al., 2014:504).

Type of provisioning ecosystem services	**Bush as the main source**	**Relative importance**	**Contribution to household capacity**
Shea nuts *(Vitellaria paradoxa)*	66%	Significant (95/100)	Food, income
Firewood	96%	Significant (101/108)	Fuel, income
Dawadawa (*Parkia biglobosa)*	53%	Significant (92/102)	Food, income
Medicinal plants	62%	Significant (100/107)	Medicine, income, cultural
Wild fruits	70%	Significant (71/101)	Food, income
Honey	70%	Significant (97/105)	Food, income
Bushmeat	61%	Significant (78/104)	Food, income cultural

Source: Field survey (2017)

Table 5.3 presents the types of provisioning ecosystem services in the study area, their sources and specific examples, their relative importance to livelihood and specific contribution to household capacity to cope and adapt to climate change. The numerator figure in the relative importance section of the Table represents the total number of respondents who answered Important, Very important and Essential (note: other responses on not using or not important and quite important, were not included here due to their small number), while the denominator is the total number who responded out of the 120 questionnaires. However, 10% of respondents on wild fruits indicated non-use which is quite surprising due to the generally free nature of the products in the area (Issaka, 2018). Could household wealth and availability of other resources explain this situation? Household level wealth of families in the study communities could not possibly be the explanation for the inconsistency since the area is classified as deprived (Ghana Statistical Services, 2014). However, the plausible cause could be the dwindled nature of forests or bush as the source of wild fruits (70%) as a result of the impacts of climate change and continuous devastating impacts of extreme episodes of droughts in the area (see Fig. 5.3). But there has been considerable reduction to the forest base of communities, most are now

restricted to forest reserves where the people are not allowed to enter without permit (Cooper, et al., 2018).

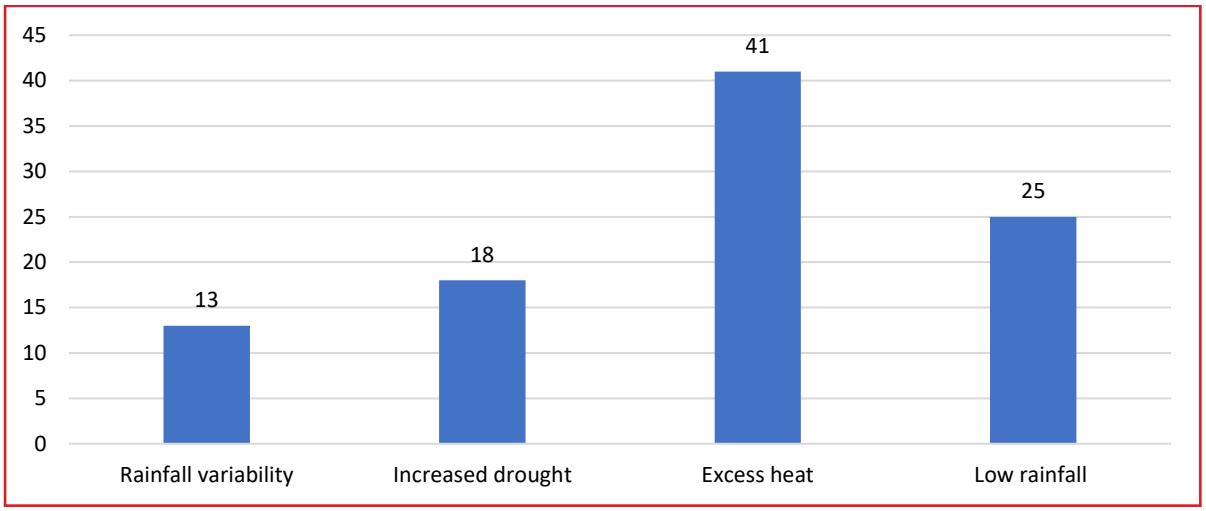


Figure 5.4: Perception of climate change over the last 30 years

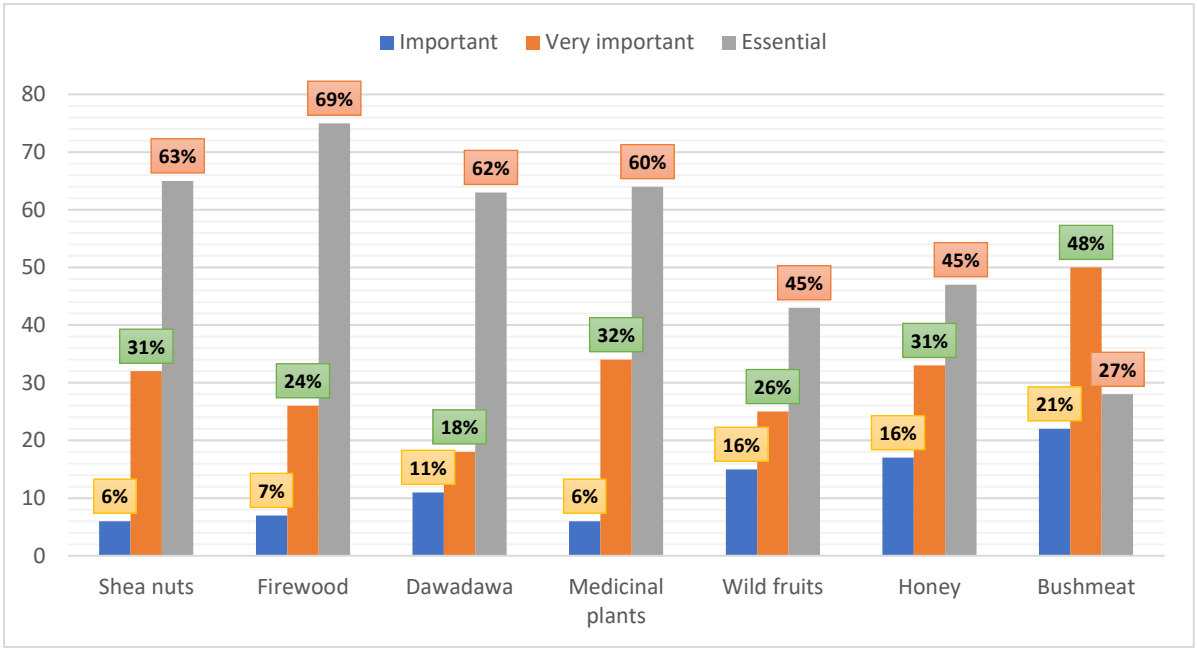


Figure 5.5: Significance of popular NTFPs in the study area.

As shown in Figure 5.5, a significant number of the respondents indicate that firewood (69%), dawadawa (62%), wild fruits, shea nut (63%) (*Vitellaria paradoxa*), and medicinal plants (60%), are among the most important NTFPs essential to their livelihoods and by extension, play important roles in their capacity to cope and respond to climate change. Put together from the questionnaire survey, respondents indicated the significant role NTFPs play in their livelihood in terms of providing food and also as a source of alternative income apart from the

main farming activities. However, the study revealed that provisions from firewood, shea nuts, dawadawa (*Parkia biglobosa*) also known as African locust bean, and medicinal plants were noted to contribute the most (see Figure 5.5). Thus, insights from the sociocultural sensitivities of natural resource use, are relevant to improve the adaptive capacity and for that matter the social-ecological resilience of local communities that depend on provisioning ecosystem services such as NTFPs for most of their livelihoods.

5.5.2 Perception of changing environmental conditions and availability of non-timber forest products

In line with the study objectives, household perception on changing environmental conditions were sought to explain how the people adapted to the impacts of climate change, and especially what principles governed their choices and responses. The study revealed that almost all (99%) households indicated that it was significant to conserve the natural environment (see Table 5.2). This high proportion of response in favour of conserving and preserving the natural environment where NTFPs that supports the livelihoods of most of the people can be understood. These responses in Table 5.2 do not make it clear whether the people are likely to accept strategies to expand the base of natural products from the wild in ways that alienate them from attachment to their cultural heritage or not. But anecdotal information suggests a strong reverential attitude of the people to their history and family heritages which permeate the general fibre of the society. Therefore, though the people will welcome any strategy to protect their natural resources and to increase their capacity to cope to environmental changes by boosting NTFP stocks, any such strategy must be formulated with their cultural heritage influences in mind. Otherwise, adaptation interventions to respond to climate change and to increase the social-ecological resilience of their SES risk local community opposition and rejection.

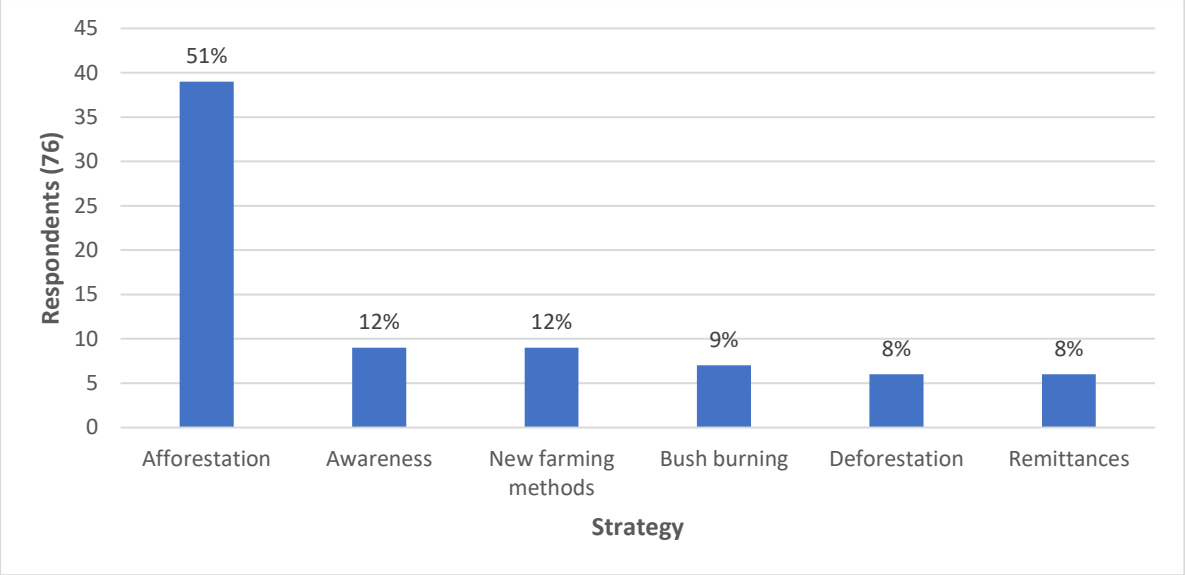


Figure 5.6: Household strategies to respond to climate change

To further understand the important role NTFPs play in building resilience, the study asked households surveyed about the main adaptation strategies they relied on. Over half of the respondents indicated identified afforestation (tree planting) as the major strategy, far above other strategies such as awareness creation, adoption of new farming methods, and avoiding bush burning and deforestation (see Figure 5.6). Remittances from family members who have migrated to other parts of the country for work was also mentioned as a strategy to increase the financial capacity of families to cope in times of stress by using such resources to purchase essential needs which they survive on.

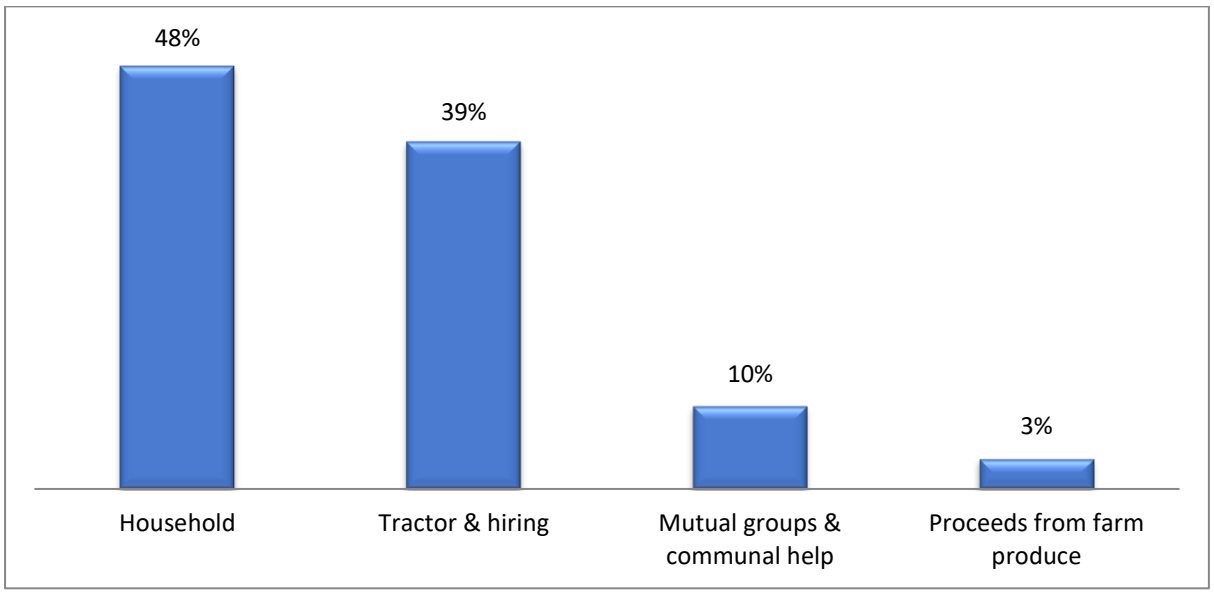


Figure 5.7: Source of farm labour

Social capital of individuals and families entails having the network support and resources through family, friends, groupings such the church, and other organizations, to benefit from or use to meet one's needs in times of distress. The access to, duration and reliability of such supports are the various questions that need to be addressed when depending on these networks. As shown in Figure 5.7, the study found that the major sources of meeting with the bulk of farm labour requirement in the area was sourced from family and household members (48%), followed by tractors and hiring of other equipment (39%). Mutual groups and communal help though not so big, are very crucial in meeting one's labour needs on the farm, in that they usually are at no cost to the beneficiary. Proceeds from the farm which is the least source, though helpful, is affected by the dwindling yields over the years, and is a source of worry to farmers in the area.

5.5.3 Influence of tradition and culture on non-timber forest products use

In various African local communities, culture and spirituality play significant roles in the daily activities of people's livelihoods, as these also affect the exploitation and utilisation of NTFPs amplifying the ways culture shapes NTFP use. The study further asked respondents about their perception on the influence of traditional practices on access to NTFPs in the study area. As evident in Table 5.2, though the use of NTFPs to support local livelihoods seemed to be widespread, there were reports of restrictions of access in the study communities with 37% of respondents confirming come form of restriction of access to NTFPs.

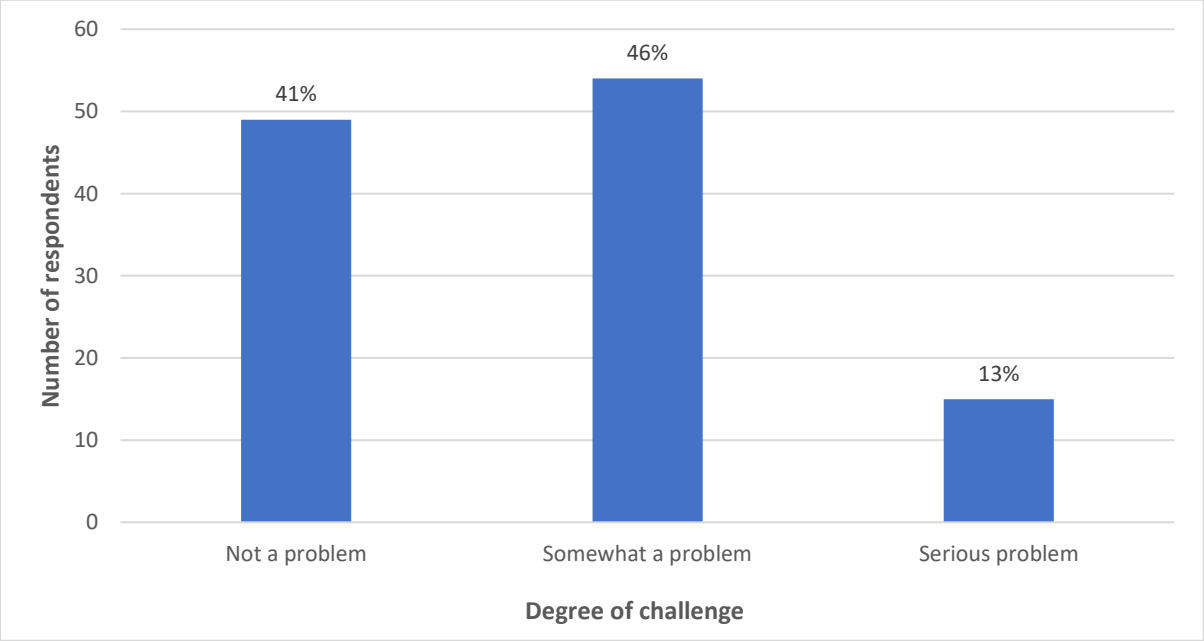


Figure 5.8: Perceived challenges to accessing NTFPs

In terms of the challenges in accessing NTFPs proportion of respondents in the study area (46%) indicates that accessing products from the wild/savannah is 'somewhat a problem'. But 41% believes accessing NTFPs is not a problem (see Figure 5.8). This result show that there is generally no problem in exploitation and accessibility of NTFPs, largely because of the open nature of communal resources. However, there are likely cultural and traditional restrictions and implications of accessing these resources such as sacred areas and sacred days when resources may not be exploited for the common good of society, making accessibility somewhat challenging. But, 61% of respondents on the question of restrictions to access to NTFPs in the area indicated there are no restrictions (Table 5.2), but this does not dismiss the influence of cultural heritage and traditional values on exploitation of some NTFPs. Evidence of 36% of the respondents showing that there are restrictions to accessing NTFPs poses challenges to the people having alternative sources of livelihood, especially in times of serious environmental crisis as a result of climate change. Such situations potentially reduce the adaptive capacity of the people to respond to recurrent impacts of drought, especially in the area. To enhance communities' resilience to cope requires an understanding of these underlying conditions and practices and their potential to restrict access to vital natural resources which do not require financial capacity to obtain. Yet still 3% did not answer on the question of restrictions to the access of NTFPs in the area. The evidence also shows consistency around access to NTFP and the challenges it may bring to the lives of local people. As a higher percentage declared that there were no restrictions to accessing NTFPs (Table 5.2), similarly higher percentage revealed that access issues regarding NTFPs were not a problem (Figure 5.8). Major sources of restrictions as indicated in Figure 5.8 below are from family heads and traditional chiefs, both of whom are designated custodians of ancestral land and resources. This scenario therefore unveils the tendency of the embedded influence of culture and tradition in people's lives. This by extension, unravels the effect traditional attributes such as cultural heritage could have by governing peoples' decisions regarding strategies to boost their adaptive capacity and to build social-ecological resilience. Additionally, as highlighted by a community elder the potential effects of restrictions to the major source of NTFP in the study area:

> *Before the reserve was established by the Government one could just go in and hunt and gather wild fruits from the forest without any prohibitions (K_ELDER).*

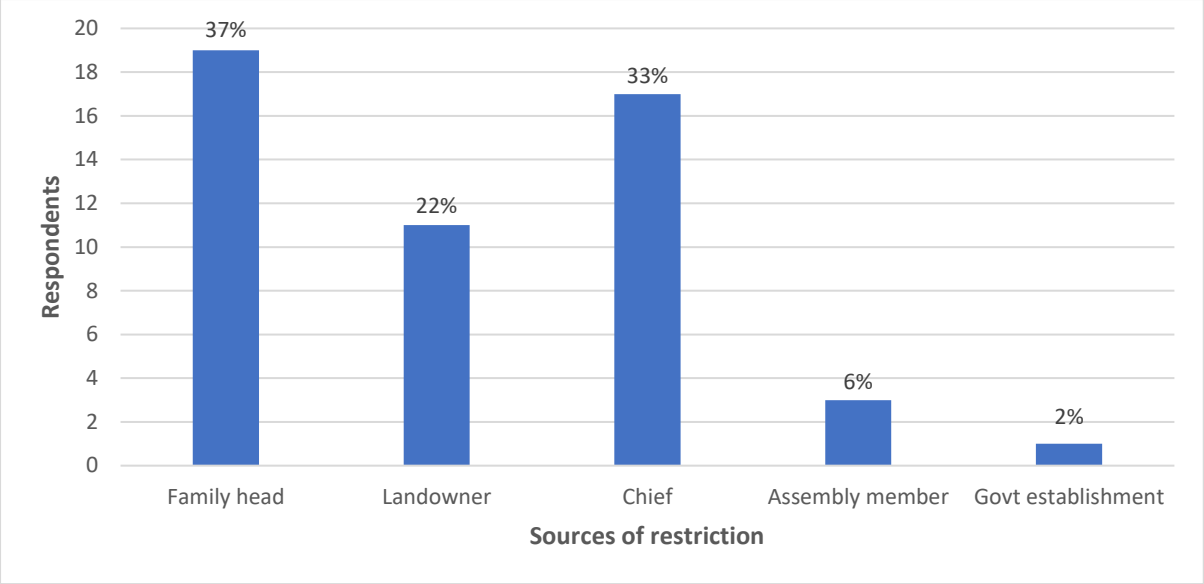


Figure 5.9: Source of restriction to NTFP exploitation.

As regards to the sources of restrictions to NTFP exploitation, family heads (37%) and chiefs (33%) are perceived to be the custodians of the culture and tradition of the people, guiding and guarding every natural resource, including NTFPs, for the ancestors (see Figure 5.9). Therefore, their voices, opinions and judgements must be taken seriously, understood and employed to devise strategies to climate change adaptation that are sustainable. This is reaffirmed by a statement from a discussant at one of the men's FGD:

> *Community rules, regulations and customs and traditions are adhered to and respected. So, such principles will be applied in all strategies to prepare for future changes (K_MEN_FGD).*

5.5.4 Dynamics and significance of popular non-timber forest products to livelihood

Evidently, forest products and NTFPs continue to be degraded as a result of the impact of climate change to the disadvantage of forest and natural resources dependent communities, exacerbating the debilitating effects of poverty, especially in drylands (Grivins and Tisenkopfs, 2018). A respondent narrated how the drought conditions in the study area continue to deteriorate as a result of climate change which is exacerbated by increasing felling of scarce trees for the production of fuelwood and charcoal for cooking and as income source. This same respondent when asked about how to respond stressed the need to advocate for massive tree planting campaigns to increase tree cover to protect the environment (D_INTV_3). However, the contribution of NTFPs to improving the livelihood of rural communities thereby increasing

their capacity to cope with changing environmental conditions is similarly evidenced in the literature (Cooper et al., 2018; Ahenkan and Boon, 2010). Evidence from this study has also highlighted the dependence of the communities on products from their natural environment with about 94% indicating they have, and continue to use products from the environment and for that matter advocate for conservation measures to help reduce its susceptibility to continuous change. There is increased recognition globally that NTFPs can significantly contribute to the livelihood of local forest dependent communities, resulting in poverty reduction and biodiversity conservation (Ahenkan and Boon, 2010; Golam et al., 2008).

Furthermore, there are growing markets for NTFP exports to Europe and other western countries as well as to neighbouring countries (Issaka, 2018; Cooper et al., 2018). Consequently, there are calls for relevant bodies and communities to focus efforts on harnessing the potential of NTFPs in reducing poverty and also building the resilience of local economies to cope with the increasing impacts of climate change (Boafo et al., 2016b). The ways this is achieved has been the focus of this study, which has sought to stress the need to understand the cultural heritage attachment of local dwellers to NTFP exploitation and usage which should not be overlooked so as not to alienate the people from their heritage and risking losing their support for viable strategies to respond to the building of resilience of local SES to climate change. The study has revealed that the people of the northern regions of Ghana extensively depend on forest and savannah products such as medicinal plants, firewood, bushmeat, honey, dawadawa, shea, and wild fruits, which are the most popular NTFPs in the area. It has also shown that these products are very important and essential in the livelihood of the study communities, therefore improving their availability and access is likely to enhance the adaptive capacity of the society, thereby increasing their resilience to climate change impacts. As evident in Table 5.2, 3% of the respondents revealed non-use of NTFPs despite the free nature of natural resources in the area, and the high levels of prevailing poverty makes it difficult to understand. Yet, possible reasons could not be far-fetched because of the dwindling forest resources and the restrictions on access (first, access to the nature reserve and second, impositions by traditional practices). To improve the conditions of the local community and increase their capacity therefore, will require that the issues of availability NTFPs and access be addressed holistically.

5.5.5 Changes and sustainability of non-timber forest products

Access to NTFPs is generally viewed as decreasing, some formerly common species are no longer available, and increasing distances to harvesting sources have generally constrained

overall access to NTFPs. The average distance to sources of NTFPs has increased about 3 kilometers in the past 10 years as a result of rampant bush burning, overexploitation, increased crop production, leading to the further degradation of such fragile ecosystems in the study area (Issaka, 2018). However, the results of this study have highlighted the significant contributions of NTFPs to the local economy and general livelihood of rural communities under study with about 80% respondents depending on NTFP provisions (Figure 5.3). NTFPs are not only very important in the livelihood of the people in the study area, but essential. Nevertheless, restriction of access to dwindling forest reserves in the study area, especially forest fringe communities like Kojokperi was viewed as a serious challenge to development in the area. Sentiments of the government failing the people which is sometimes looked at as a betrayal since their access to the resources from the forest reserves had been curtailed with dire consequences were shared in most of the communities surrounding the forest reserve established by government of Ghana, and was echoed by an elder from one of the communities that their nutritional provision reduced considerably after the creation of the forest reserve:

> *Before the reserve was established by the Government one could just go in and hunt and gather wild fruits from the forest without any prohibitions (K_ELDER).*

Consequently, the environment from which these are obtained must be protected and improved in order to sustain such products, which form a substantial proportion of the resource base of the people. Most times the products from the natural environment are sold to generate income to meet household needs such as paying for hospital bills and children education. It therefore underscores the relevance of incorporating the income provision from NTFPs to that of the incomes of households and communities in order to enhance the capacity of the local systems thereby improving the resilience of rural livelihoods, consistent with other studies in similar locations (Issaka 2018; Sammaddar et al., 2018; Nyantakyi-Frimpong and Bezner-Kerr, 2015). But, the increasing call for the domestication of NTFPs such as wild animals (eg. grasscutter farming) and the development of plantations leading to commercialisation of NTFP produce thereof (Delgado et al., 2016), though having the propensity to improving local livelihoods and, or achieve conservation targets, thereby helping in poverty alleviation and the building of resilience, raises serious implications for the rural population. Conflicts on access to NTFP products could jeopardise and hamper development in the already fragile ecosystem, land size and tenure issues can be exacerbated, it could also escalate existing marginalisation and inequalities in communities. These are some of the problems that need attention in order to achieve the objectives set out in climate change programmes and interventions. There is

therefore the need to develop holistic approaches in response to the changing conditions of dryland areas such as the study sites. Innovative means of integrating the agricultural, forestry and NTFPs production and exploitation consistent with studies such as Issaka (2018) in the study region, are highly suggested in order to strengthen local farming and livelihood systems and build their resilience to climate change. But the local communities were left without any alternative means and they saw their livelihood options diminished considerably. As a community elder described the situation in an excerpt below, the community did not have any alternative to the hunting they lost to the creation of the reserve:

> *There was also no policy to design any other economic ventures as alternative to the hunting we are so used to (K_ELDER).*

The debate on the significance and contribution of NTFPs in local economies and livelihoods towards the building of the resilience of local social-ecological systems to climate is out of question. But, as some may seem to suggest that NTFPs incomes are not significant (Ambrose-Oji, 2003) for forest fringes in Cameroun, this study however, has demonstrated NTFPs value and contribution, supporting studies like Shackleton et al. (2007) that concluded that NTFPs make significant employment and income contributions in areas other than the humid tropics. Consequently, contexts in the form of geographical factors of prevailing forest and vegetation cover type determine to a large extent of how and why communities engage in wild products collection (Cooper et al., 2018) and their considerable contributions. These factors also largely predict the likelihood of NTFPs exploitation.

5.5.6 The challenges of the principle of attachment to cultural identity and social-ecological resilience

Traditional African practices across communities have displayed a consistent character with ES approaches to natural resources management over time, though a recent tool (Chiotha, et al., 2018). Resource utilisation and conservation in most African communities embodies spiritual connotations resulting in respect for nature and resources of plants and animal components (Gumo et al., 2012). Such spiritual aspects of the human-nature interplay largely inform how people plan and live harmoniously with their natural environment in the best possible way (Chiotha et al., 2018). Therefore, local communities must be involved directly in afforestation and conservation projects. But involving communities is likely to serve an incentive to the local people for them to contribute to implementing such activities and projects in the long-term (Likoswe et al., 2018). The case of historically existing informal processes of

collection and utilization of NTFP, which is oftentimes ignored in policy instruments and regulation could serve as disincentive to attract the commitment of local communities to fully embrace resilience programmes (Delgado et al., 2016). A typical example is traditional knowledge on the sources, access and use of NTFPs, which is passed on through generations and usually serves as the platform to empower local communities to adopt strategies that invigorate and expand the resource base of communities (Delgado et al., 2016). This is highlighted in the account of an elderly man in a key informant interview:

> *Everything one gets from the forest was used to cater for family needs. Game was available to most people so no buyers even if you want to sell, it formed about 70% meals (high protein) (K_ELDER).*

5.5.7 Implications of expansion, commercialisation and cultural attachment to non-timber forest products collection

There are challenges of dwindling stocks of most NTFPs as a result devastating impacts of recurrent environmental degradation, especially the effects of drought in the study area and elsewhere in Africa (Issaka, 2018; Likoswe et al., 2018) which needs to be addressed in order to improve the livelihood systems of resource-poor communities. Expansion and commercialisation of dwindling stocks have been advocated as viable ways to resolve this problem in order to avert the scenario of local people running out of sources of NTFPs. However, there exist a gap on the crucial role cultural heritage attachment play. The successful implementation and sustainability of climate change mitigation and adaptation strategies in local communities hinges on the desire and ability to link and sustain the sociocultural connections of the people to the land. As has been aptly discussed by Berkes et al. (2009) highlighting the need for adapting cultural connections to the land as strategies are devised in order to renew and sustain ecosystems for livelihood enhancement. They suggested approaches to resolving challenges of climate change, but stressed that local traditional knowledge, cultural legacies, social institutions and social networks play critical roles in sustaining the use of ecosystem services among other approaches. Subsequently, it is instructive to learn from anecdotal view expressed by a community elder which reiterates the traction of traditional knowledge in natural resource use:

Coming from a hunter-gatherer ancestry, we pride ourselves in the heritage of hunting and gathering wild fruits, not necessarily for the products sake, but for the symbolism and perpetuation of tradition (Anecdote: K_ELDER).

Evidence from this thesis therefore highlights the need for incorporating the principle of cultural heritage attachment and legacy of local into strategies of building resilience and sustainability of SESs in responding to the impacts of climate change in the long-term. It is imperative that feedback in the form of past ecological knowledge and legacies embodied within the culture of the people are understood, harnessed and adopted to ensure that the acceptance, support and enduring trust of the people necessary for long-term survival of projects be obtained. This notion is exemplified in an interview with wildlife officers who stressed the need for cooperation of the local community to be a priority to sustain forest conservation whilst trying to meet the needs of the people:

Dry season farming and strong regulations on forest conservation can support community needs and build strong community relations with wildlife officials (GWC, Officer).

It is against this backdrop of the role of tradition and culture as well as traditional knowledge in the conservation and sustainability of NTFPs that the main finding of this chapter supports the idea of careful scrutiny of commercialisation of NTFPs in forest-dependent communities as a strategy to improve livelihood, in order not to disrupt traditional cultures and legacies which underlie community-natural resource relationships that risk undesired transformations. It is therefore instructive to note that one of the men's FGD stressed the need for cultural principles and traditions regarding natural resources use and improvement, become a priority:

Community rules, regulations and customs and traditions are adhered to and respected. So, such principles will be applied in all strategies to prepare for future changes (K_MEN_FGD).

Removal of access to forests and for that matter forest products in terms of PES could pose serious nutritional and economic challenges to local communities which needs to be handled carefully to avert such problems. Understanding the sociocultural characteristics of the community, and uncovering whether there are any underlying principles, and how these govern decisions and choices about livelihood activities has been an overarching focus of this thesis. Such insights could help to fashion and implement resilience strategies, regulations and policies that are likely to receive the full support of the people. Therefore, regulations and policies aimed at improving the well-being of local communities must be drawn incorporating local

knowledge and principles in order to bolster, rather than alienating people from their cultural beliefs and practices. In so doing the long-term benefits of the effects of these policies possibly could build the capacity of stressed communities to cope and respond to climate change. Nutrition for instance stands to be hampered when dwindling forests are restricted to local people. This is more crucial for vulnerable members like children, women, and the elderly. Golden et al. (2011) found in Madagascar that children anaemia rate would increase by 29% because of reduced meat consumption resulting from the removal of access to wildlife (Cooper et al., 2018).

Forests offer aesthetic and cultural values, creating a sense of cultural identity and spiritual enrichment. Such provisions must be broadly be addressed when designing resilience strategies to respond to climate change. Crucially, building value chains focused on certain NTFPs that provide cultural value for society through improved processing technologies, creating established producer groups and marketing viable processes, in the desire to commercialise, should be addressed carefully to ensure that local cultural heritage and legacies are incorporated. Invariably, it is important to ensure that commercialisation does not undermine local livelihoods and cultural attachments and identities (Shackleton and Pandey, 2013), as identity and place remain fundamental to people's attachment and attitude toward the environment, which must be addressed to foster pro-environmental behaviours among local communities in the face of exacerbating climate change conditions (Brown et al., 2019). Ostensibly, the need for counting the altruism potential and intrinsic value of relationship between NTFP use and cultural identity, but discounting the transactional connotations of identity related to commercialisation of NTFPs without factoring cultural identity and associated components, could be a disincentive.

5.6 Summary

This chapter has focused on understanding the connections between sociocultural factors and the expropriation of NTFPs, and the implications for building resilience of dryland ecosystems through adaptation and mitigation strategies to climate change. Decisions and choices are unpacked to understand the underlying principles that govern how people respond to the climate variability and change with focus on the links between the provisioning ES and the cultural services. This thesis argues that social-cultural processes that underlie provisioning ecosystem services harvest and use are much stronger than previously known, and must be studied and understood much better. Attachment to cultural heritage in particular seems not to have received much traction in the mainstream resilience and development literature, despite

potentially holding power that can influence which activities people may decide to align with and accept. Although anecdotal evidence points to women being better environmental managers (planting and weeding after men), and also being the main agricultural producers in sub-Saharan Africa (FAO, 2011), they had next to no control of land in the study area. This situation has implications for NTFP production and exploitation, which has to be addressed in order to improve access and for the benefit of households. The dwindling nature of natural resources as a buffer against the effects of climate change, which has resulted in calls for deliberate measures to expand their base, was examined in this chapter. It focused on the need to untangle the implications of religious and traditional practices associated with the use of NTFPs and the improvement of the resilience of local communities. The overarching aim of the thesis has sought to understand this phenomenon of cultural attachment, emphasising that such insights could boost the acceptance of climate adaptation measures and to forge long-term partnership necessary for the success of resilience strategies.

Climate change is expected to critically affect the supply of PES to various communities around the world, but the case of semi-arid regions especially, are more exposed, vulnerable and dire. However, PES will continue to remain significant in the livelihood responses of most communities, and the findings reveal that NTFPs contribute significantly to the livelihood of the people by way of meeting their basic needs of food, shelter and providing alternative income from the sale of NTFPs products, especially to the poor and vulnerable. They are strongly embedded in the socio-cultural and economic systems. One of their main significant values apart from helping households and communities to meet their basic needs, is the aspect of maintaining the cultural traditions and knowledge of a people (Shackleton, 2015).

NTFPs are essential part of the people's lives and well-being in the DBI district, proving their essential needs rather than just desires as may be perceived by outsiders. Vegetables for example are a core part of cooking of the main meal of the people, which must be available in and out of season. Thus, the call of the people for facilities such as dams to aid dry season farming to ensure a continuous supply of vegetables and other condiments essential for their well-being. However, evidence shows strongly that resource base of NTFPs continues to dwindle as a result of the continued impact of climate change, as is the case in the study area where severe drought and long season of dryness have continued to affect agriculture which is the main stay of the people. Much needs to be done to find ways of integrating and expanding NTFP production and agriculture in the area. But understanding and prioritizing the historical and cultural attachments people have with wild products from the forest and savanna will foster

cooperation and acceptance that can ensure the success in climate change strategies. This will improve the capacity of communities to cope with changes and build their resilience to climate change.

The main finding of this chapter, which has addressed the three research questions of this thesis (see Table 4.5), shows the critical role of peoples' attachment to cultural heritage associated with NTFPs exploitation and use that makes it imperative to deliberately address it in order to obtain the necessary buy-ins in the form public acceptance to resilience activities that involve NTFPs. Though, some research has been done in trying to understand how to maintain the cultural values of NTFPs (Shackleton et al., 2018; Shackleton and Pandey, 2013), almost none has recognised the aspect of people's attachment to symbolic NTFPs which if not addressed may have negative implications toward the promotion of increased access to NTFPs through commercialisation. The study consequently highlights that it is important to focus and adopt locally engineered approaches that are framed within sustained cultural and traditional practices that society can identify with and work with. Cultural legacies, social networks and institutions are very crucial systems that have to be identified, understood and applied to build the capacity of local resources stocks, whilst enhancing the adaptive capacity of SESs to build social-ecological resilience. The analysis and discussions in this chapter have attempted to answer the three research questions of the thesis by focusing on the key underlying principles that govern people's decisions, and the evidence of these in the study area. The composition of the FGD participants based on age and gender status allowed for the differences in their diverse and unique experiences, perceptions and premonitions about the influence of intent-driven trust on enhancing climate adaptation interventions to be captured. It is noteworthy that due to the strong patriarchal system operational in the study communities, women were deemed by men as less knowledgeable in community affairs and unable to keep secrets. Nonetheless, agreeing to interview and focus group participants in their convenient locations helped to ease such challenges.

Overall, the multiple sources of data from diverse segments of the society (men, women and youth) helped to capture various viewpoints and insights about sociocultural principles relevant to building resilience as perceived by these different groups. Women for instance, highlighted during the FGD that although they are naturally viewed as 'weak', they still engaged in certain farm activities which are considered the preserve of men. Ironically, they are customarily required as part of their marital obligations to assist in their husbands' farms. Though this may be viewed as a good thing in terms of increasing family food and other natural resources, it

might not favour women that much as it will cause them to lose time which they could use to engage in other income generating activities to augment their income. Another interesting aspect that may have played a nuanced role in the information gathered during the research is the religious affiliation factor. As described earlier in chapter four, the eastern part of the study area is predominantly Muslim, whereas the western part is largely Christians. Both religions have their influences on what activities their members, especially women, can engage in or be associated with. This tendency potentially directs and underlines the choices followers of such religions would make, and invariably dictates the resilience strategies they may adopt. For instance, women in the east may not engage in the business of the local alcoholic beverage (pito) due to their affiliation to Islam, which would largely reduce their capacity as a result of reduced alternative income. But no evidence emerged that suggested any tension between the people's tradition and culture, and religion, it appears all such persuasions do co-exist without notable conflicts. By and large, the nuanced effects of these differences will not obliterate the significance of the findings of this chapter. Rather, they may serve to affirm the need to build into climate adaptation strategies the notion of 'cultural attachment' that may become obstructions in the course of delivering resilience outcomes if not well served in resilience processes. The next chapter highlights the influence of the principle of trust in building resilience.

Chapter six

Exploring the influence of trust as an underlying principle of building resilience

6.1 Introduction

Climate change, severe weather conditions and environmental hardship around the world have continued to be among the world's greatest challenges in recent times. With anticipated increases in environmental change, adaptation to climate change in particular has become a necessity (IPCC, 2014). Vulnerable populations in the developing countries are the most affected, as their livelihood options continue to shrink. Households adapt to changes both individually and collectively (Tompkins and Eakin, 2012). However, myriad factors mediate the ability of households and communities to adapt and cope with the impacts of climate change. Crucially, factors of enhancing the adaptive capacity of individuals and communities, while building resilience such as access to financial, human, physical and social capital are most often in sharp decline, if not, non-existent in most communities in the developing world where the impacts of climate change are hard felt.

However, little attention is given in the literature to the role of social capital in the form of collective action and cooperation, which are underpinned by the principle of trust, between and among community members, groups and institutions geared toward mitigating and adapting to climate change (Paul et al., 2016; Keys et al., 2014; Jones and Clark, 2013). Trust may range on a continuum from personal to abstract (Newton, 1997). Newton (1997) described trust in three forms: Thick trust (usually within small communities with a generalized mistrust towards the outside world), thin trust (associated with networks of voluntary groups entailing personal interaction necessary to achieving group virtues) and abstract trust (where active engagement is not a requirement). Such distinctions necessitate the need for insights on the underlying conditions within the social fiber upon which local communities' actions or otherwise may be connected. Less abstract forms of trust, laden with the idea of intent-driven attitude of actors could be viewed as an effective way of stimulating community acceptance and commitment to climate adaptation strategies. It is necessary that such attitudes are not perceived by local communities as preclusive, ephemeral, playing down problems, or ascribing alien ideas.

Instead, intentions of external actors must display and have as their guiding principle, the notion of 'good faith' at all times (Sauri et al., 2003).

Kramer (1999:570) asserted that trust could be looked at as 'the expectation of ethically justifiable behaviour'. But this thesis can stress also that culturally justifiable behaviour is fundamental to showing 'intent-driven trust' to the community in order to gain their acceptance and commitment necessary for the success of resilience building interventions. This thesis uses the idea of intent-driven trust to refer to, and underscore the critical need for highlighting from the outset, the core demonstrable intentions of external actors, which should be emphasized throughout the lifespan of interventions. As Sauri et al (2003) reported in their work on how the Donana community in Spain disregarded the government's intention and focus on compensating them following the toxic spill disaster, though a needed intervention at the time. Thus, trust, and for that matter, acceptance, could have been fostered between the government and the people if deliberate actions were taken to intentionally express the government's desires and aspirations genuinely to the people. This is why this thesis stresses the need to unpack the attributes of the notion of trust underlying people's decisions, and intentionally seek to emphasise them from the outset.

The key aim of this chapter of the thesis is to examine how the principle of trust embedded within the broader concept of social capital influences community attitude and action toward building resilience. To answer the three research questions and to address the key aim of this chapter (RQ1: How do households and communities respond to the impacts of environmental stresses? RQ2: What key principles underlie peoples' responses to environmental changes, and why? RQ3: What evidence is there that these principles are socially and ecologically relevant in building resilience, while remaining relevant to the local people?), it is necessary to study the design, introduction and implementation of adaptation strategies to uncover significant underlying principles. This chapter argues that an appreciably high levels of what is asserted here as 'intent-driven trust' between local people and external actors or organizations, is a necessary precursor for the successful introduction and implementation of climate change mitigation policies.

Samaddar et al. (2018) in their study to explore the effect of trust in disaster preparedness information communication find that local leaders are most trusted source of communication and must be considered seriously when designing programmes. They also observed that acceptance and dedication to the source of communication depended on individual's general

attitude and experiences, which are shaped by their cultural values and norms. Consequently, the value and authority of local traditional leaders must be considered seriously within any climate change mitigation strategy. Moreover, building resilience and making local vulnerable communities responsive to change requires a deeper understanding of the broader sociocultural livelihood system of the people, in relation to natural resource use and management. Managing the 'commons' (natural resources belonging to all the members of the community) for sustainability however comes with its own challenges of what responses to adopt, who holds authority, who qualifies, etc., and all these influences the way communities organise response strategies to cope with change (Ostrom, 2011).

Drawing on mixed method data (see Chapter 4) from the semi-arid regions of northern Ghana, this chapter explores the notion of trust as a social capital element and to understand its contribution toward sustainability and the building of resilience interventions. It examines the influence of social capital, and especially, the nature and level of trust on community's desire and long-term interest to accept, own and protect ongoing interventions in the face of climate change. These areas continue to experience unprecedented environmental changes, particularly, the effects of climate change over the years. This is a situation which has been escalating in recent times and has the potential of further plunging millions of vulnerable people in Ghana into catastrophic hardships (IPCC, 2014). The three northern regions in Ghana and especially the study area, are the most vulnerable to climate change and drought conditions. Such changing conditions have continued to increase over the years and have become quite intense in the last ten years, changing rapidly (see Figure 6.4 below where 79% of 95 out of 120 respondents said the climate is changing rapidly in the study area). Two devasting floods for example affected the northern Ghana in 2007 and 2008, resulting in 61 deaths and affecting nearly 317,127 people. Additionally, over 70,500 hectares of agricultural land were affected with dire consequences on food production and livelihood in general (Samaddar et al., 2018). The 2008 flood alone has been estimated to have resulted in a financial loss of about $ 5,813,954.70 (Oteng-Ababio, 2013).

Such changes therefore require developing strategies that prepare communities and households building their capacity to respond appropriately to, and adapting to changes. However, the success or otherwise of any intervention depends largely on credibility of the true intentions of developing it in the first place, and also on the manner of its introduction. Despite external institutions and organizations rolling out good public policy interventions, communities are more likely to associate with agencies they perceive have good intentions and can trust would

deliver as promised from the outset (Paul et al., 2016). If they cannot trust in the resilience projects, participation could be hampered, implementation will be difficult and sustaining for the future is likely to fail (Leitch et al., 2015). Understanding local perceptions about climate change policy interventions and public engagement through local community characteristics, such as the nature of social networks, is essential (Lorenzoni et al., 2007) to encourage local stakeholders and citizens in policy decision-making processes (Milligan et al., 2009). Consequently, efforts must be made to identify social parameters which are recognised by the people as important and will be influential in gauging citizens' reactions towards, and acceptance of public policies (Grafton, 2005). Subsequently, examining parameters such as the level of trust in external institutions and responsible organizations especially, will be extremely useful (Myatt et al., 2003) in seeking public engagement. Social variables especially, have been shown to exert considerable influence on the extent of adaptation, especially in the area of project acceptability, buy-in and support (Adger et al., 2009; Adger, 2003), where trust plays a central role in galvanising public cooperation, acceptance and collective action (see figure 1).

The rest of this chapter continues to examine the interrelationship and influence of the concept of social capital and its element trust, the social license to operate and acceptance, as essential underlying factors in determining the success of climate change adaptation and mitigation policies. The theoretical framework upon which the various concepts are described is presented, followed by and the results which are discussed, and conclusions drawn.

6.2 Theoretical framework: Social capital, trust and social license to operate (SLO)

6.2.1 Defining trust within the broader concept of social capital

Due to complexities, uncertainties and interrelatedness of climate change and other environmental changes, projects towards building resilience demand that any public policy must be well planned, carefully sequenced and a wide variety of physical as well as social variables are to be incorporated (Mearns and Norton, 2010) to foster the inclusion of local preferences and viewpoints into policy instruments for acceptance and a better and long-term outcome. It is therefore important to explore the interrelationship between the influence of social capital on climate change mitigation measures and the social impact of relevant policy interventions. In the same token, there is the deep sense of urgency to explore the influence of trust as a crucial element of social capital, on policy interventions and their connectedness to social impacts of such relevant policy frameworks. Perceptions of positive or negative impacts

from different policy options can quite clearly influence acceptance or rejection and affect the ultimate outcome of interventions (Tompkins and Adger, 2004). But, Jones and Clark (2013) rightly argue that it is the inherent stock of social capital the individual and the community possess that conditions the locally perceived social acceptability of any policy mitigation strategy (see Figure 6.1).

In many situations, community decision-making and choices to respond to change which are embedded within sociocultural values and principles, though generally subjective, are crucial decision points and precursors for actions. In our case, these social variables are broadly framed within the notion of social capital of communities which possesses multidimensional characteristics and complex nature. Three elements of social capital of communities identified in the literature and relevant to this chapter include, social trust (referring to trust among community members); institutional trust (encapsulating trust in community/public institutions); and social networks (which can be grouped as bonding between group members, bridging between members of different groups and linking between groups with different authorities) (Jones and Clark, 2013; Putnam, 2000).

Social capital as defined by Woolcock and Narayan (2000) refers to both the cognitive and structural characteristics of a social group that facilitates its members to act collectively. It is therefore necessary to understand the role of trust as a major aspect of social capital and how it underlies local communities' decisions to accept and align with climate adaptation strategies for successful outcome. Consequently, successful long-term outcomes potentially could improve the adaptive capacity of households and communities, which then helps in building social-ecological resilience to climate change. Furthermore, there are emerging concepts such as Ecological Solidarity that examines human-environment relations as interdependencies based on trust and reciprocity that go beyond notions of services or feedbacks (Mathevet et al., 2016). These concepts highlight the interdependencies and links that exist between the human and non-human spheres of life, and thus, their mutual co-existence and solidarity fostered by the element of trust must be given the serious attention that it deserves. Ostrom (2011) had observed that all action situations comprise of the biophysical, the attributes of the community and institution. Thus, trust functions as an attribute of the community through which members play a critical role in engagement or disengagement, and in fundamental terms, of collaboration and collective action toward the sustainability of resilience strategies. Additionally, the social, cultural and political backgrounds of different communities may crucially influence perception

of what truly matters and determines trust, and for that matter, acceptance and compliance (Zhang et al., 2015).

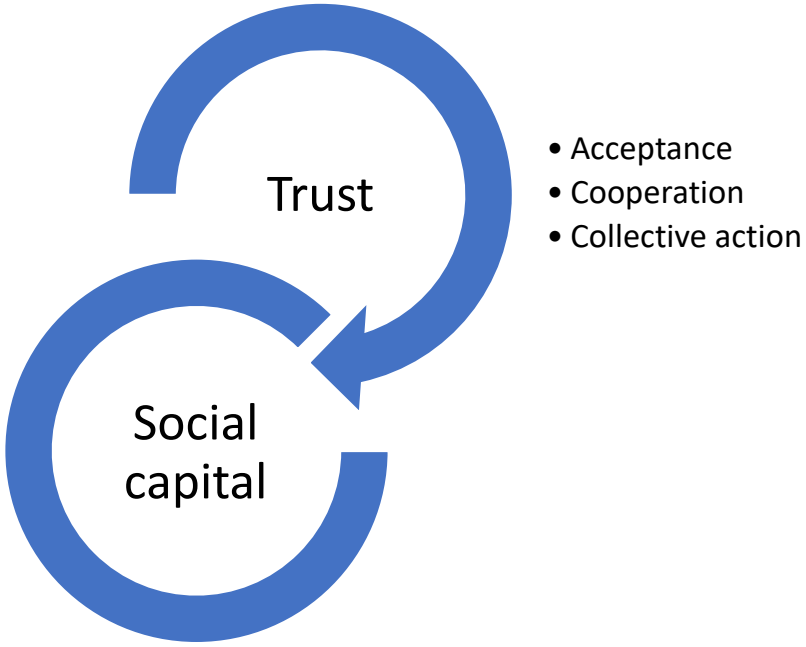


Figure 6.1: Interrelationship between trust and social capital (Original to the Author, 2019).

Figure 6. 1 shows trust as a central element linked to social capital which harnesses community resources and fosters collective action towards adaptation to climate change. Through trust, cooperation among community members is mobilised leading to collective action, which in turn ensures public acceptance of climate change adaptation and mitigation policies.

6.2.2 Trust and social license to operate

Trust-building tendencies of entities like organisations must be developed over time to enhance the success of society's interactions and cooperation within and without, originating from attitudes which are embedded in social norms such as reciprocity (Chrupala-Pniak et al., 2016). It is based on the level of such interactions and cooperation among community members that policies may either be embraced or rejected without reaching the intended outcomes. A related concept to acceptance called 'social license to operate' developed within the mining sector, is described as social acceptability to operate, and has been adopted in most areas of corporate

and industrial activities in communities within the forestry, agriculture and the energy sectors (Moffat et al., 2016). It explains the processes by which communities accept and allow companies to function in their jurisdiction based on mutual trust of companies to fulfil their environmental and social responsibilities (see Figure 6.1). SLO, though developed in the mining sector has relevance to this study by drawing insights on the processes of community acceptance, which this thesis explores links with the concept of trust. The concept of trust which is the focal principle examined in this chapter possess the potential to bridge and also enhance the mobilisation of the three community attributes (acceptance, cooperation and collective action) shown in Figure 6.1 necessary for successful implementation of long-term projects. As societal expectations of how industries extract natural resources rise, communities are increasingly demanding a more active involvement in the decision-making process that guides industrial activities. Concerns of high cost of negative social and environmental impacts of the activities of industries on the natural environment such as chemical spillages, dam failures coupled with increased awareness and change of societal values and attitudes towards the natural environment (Thomson and Boutilier, 2011) have over recent times caused communities to demand more involvement in the operation of industries.

Underpinning social license to operate are the elements of trust, fairness, and governance which Moffat, et al (2016) have explored to examine their role in the development of a more sustainable trust-based relationships between industry and society. It is in this regard that the understanding of the role of trust in the relationships between stakeholders and all actors and its impact on resolving conflicts, improving acceptance and sustaining implementation of resilience interventions is crucial in attaining a sustainable future for society (see Figure 6.2). Trust as a crucial element of social capital plays out as respect, discipline and truthfulness exhibited between parties working together to achieve desired outcomes (Habermas, 1984).

Significantly, engagement between social capital and public policy unfolds in two ways; first, as how trust or social reciprocity is manifested in communities (Adger, 2000; Lorenzoni et al, 2007); and second, the role of connectivity between people and organizations within and across communities (Adger 2003; Tompkins and Adger, 2004). Thus, the function of trust could facilitate, and foster community acceptance of policy interventions geared towards building resilience. Without attention to the principle of trust the development and implementation of climate change strategies may not be sustainable, let alone produce the desired outcomes as intended. The questions on why people may not respond favourably to interventions that could enhance their ability to cope and thrive in the face of change, may continue to require attention.

But, success to resilience strategies will largely depend on how trust between stakeholders is forged, nurtured over time and sustained for the long-term, especially with the building of social-ecological resilience as the goal. The notion of trust will need to be addressed at all stages of decision making and implementation phases of strategies to achieve desired outcomes. Local communities are always concerned about and looking for fair treatment and expecting to receive high-quality and respectful engagement with organizations. These generally constitute the predictors of the level of trust in relevant organizations, and the subsequent acceptance and approval of their operations and activities by the public (Moffat et al., 2016). Withholding and or withdrawing trust and SLO, usually done implicitly, will largely undermine the success of climate change policies and strategies, affecting resilience and sustainability in the long term, as depicted in the figure 2 below.

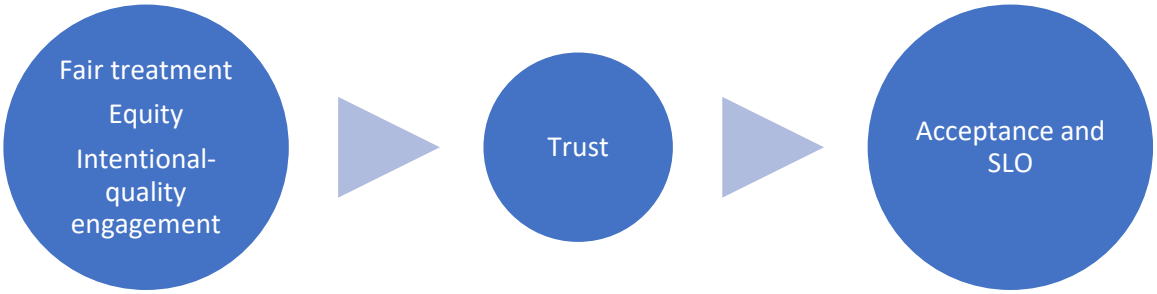


Figure 6.2: Trust, public engagement and social license to operate. Modified from Moffat, et al. (2016) model of social license to operate, pp. 484.

In figure 6.2 the principle of trust mediates between essential elements of public engagement and subsequent acceptance that pave the way for resilience strategies to yield the intended high outcomes. Perceived fair treatment, equity and intentional quality engagement with the community enhance trust between the community and other actors which then result in public acceptance and the green light or social licence to operate. High levels of trust therefore likely to ensure high acceptance and compliance to policies by the public.

6.2.3 Wong's (2007) framework of agency-institution-structure

It is insightful to note that social life of communities is such a dynamic collection of aspirations, attitudes and actions that is not easily understood and finely defined. Most of the time the messiness in social lives is judged and valued by mainstream social capital approaches using the seen attributes. Whereas, most 'unseen' factors and principles that mediate everyday practices are at best glossed over (Wong, 2007). By this framework of understanding the operations and benefits of social capital to local communities, Wong advocates a new pro-poor social capital perspective away from the ideal 'seen' organisation-based, purposefully crafted social capital that usually may not benefit some sections of society it is originally meant to help. He proposes the concept of 'unseen' social capital via an 'agency-institution-structure' framework that is designed to capture the dynamic processes and outcomes of societal interactions. Wong defines Agency as people's subjectivities, meanings of, and motivations for social cooperation, whereas Structures refer to the enabling and or the constraining factors that under guide people's participation in their communities, and finally the framework describes Institutions as including formal organisations and social norms and values that mediate and embed practices and shape interactions.

The central focus of this chapter therefore is to examine in-depth these 'unseen' principles of social capital such as trust that mediates everyday livelihood practices of the people and motivates people's actions in terms of participation and cooperation geared towards strategies in building resilience in environmentally stressful ecosystems like drylands. It explores the manifestations of trust in the study communities to identify its underpinnings and links to Wong's (2007) framework of unseen social capital. Conventional social capital analysis may be useful in some ways to mobilise resources to build the capacity of communities in responding to change. But as Wong noted, social capital is most of the time intentionally crafted towards specific goals that may undermine poor peoples' already diminishing social capital. There is therefore the need to draw broadly from underlying principles and factors that mediate people's everyday practices and choices to fully understand and to generate a social capital that maximises the greater benefit of society. Insights from such understandings are crucial in order to help devise comprehensive foundations for resilience strategies to succeed and achieve the desired outcomes.

6.2.4 Linking social capital, trust and building of resilience: public perception, acceptability and compliance

Samaddar et al. (2018) suggest that associated risk with climate hazard alone is not enough to pursue affected individuals and communities to accept communication materials related to mitigating such hazards. But one key deciding factor in accepting and following communications is the element of trust in the source. Trust helps to mediate the inherent uncertainty and complexities that surround adoption of interventions and is likely to play a crucial role in determining outcomes. Talvitie (2011) cites that trust is the artificial structure that bridges the gap left unfulfilled by force or reason alone. Habermas (1984) suggests that trustworthiness is based on truth, rightness and sincerity. Rivers III and Gibbs (2011) also indicate that higher levels of compliance to policies and regulations can be achieved when the beneficiary community or the individual trusts the authority figure or agency administering and overseeing the process.

Similarly, Elser et al.'s (2002) suggests that lower trust in the source of information leads to lower risk perception and then lower acceptance of suggested counter measures. Also, the level of perceived trust emanating from the perceived intention of agencies providing adaptation strategies to climate change and as measures for building social-ecological resilience, is a crucial factor if intended programmes are to be successful. Perceived intentions of providers by the public are likely to inform the disposition of the local community which could then reinforce or ameliorate any skepticisms, doubts and uncertainties. These perceived intentions (manifesting in the form of genuine and fair engagement, etc.), if they are positive could result in high levels of trust between actors thereby increasing the chances of acceptance and subsequent adoption of the policies. It is therefore important that the idea of 'intent-driven trust', which connotes actors taking every possible means to unveil their intentions for resilience interventions to communities early on at the inception stage. The local community must be able to count on the integrity of external actors, and that they mean well for the people. Consequently, verifiable actor success-stories in similar programmes could serve in new ventures by helping to clarify any suspicions local communities may hold.

Ultimately, the kind of intervention, actors and resources available, will all be crucial considerations in the success or otherwise of climate mitigation and adaptation policies (Terpstra, 2011; Paton, 2007). However, interactions existing between individual members of

the community, and between individuals and institutions on a regular basis could provide the space for local actors to observe and evaluate underlying subjective actions and intentions of external agencies. And this may allow trust to evolve to either impede or enhance the level of public engagement, acceptance and implementation of strategies and to build resilience to climate change in the long term (Jones and Clark, 2013).

Additionally, Talvitie (2011) points in his work on the problem of trust in the planning process that conceptualization of trust in sociological terms identifies all actors as individuals, the relation between them as social relationships, and the various institutions and interventions as social systems. Thus, the element of trust must be situated and addressed via all the three areas (trust of individual actors, trust in relationships between actors, especially between locals and externals, and trust in the operating system of interventions). It is therefore in the area of bridging between the various aspects of project institutions, acceptance and implementation that the element of trust is needed to intermediate the intended outcomes and perceived intentions of principal external actors (Paton, 2008). It is also anticipated that trust will mediate belief and action (Terpstra, 2011) when it is appropriately addressed leading to openness, fairness and clarity. Though, fostering quality engagement and trust between members of the community is important, the central argument here is that, no matter what the scientific success or otherwise of impending climate mitigation strategies in communities, the perceived original intentions and trust in the providers by the locals is paramount for a successful outcome (Paul, et al., 2016). And that the element of trust mediates knowledge and expertise, stresses openness and honesty, requires concern and care, as the critical determinants of acceptance and adoption (Peters et al., 1997).

It can also be argued that diversity of interpersonal trust within small groups, though necessary for alternative ideas and views, can adversely affect cooperation and lead to disengagement, distrust, and frustration. Moreover, research supports that the tendency to trust correlates with the intention to do so even if partner's trustworthiness is ambiguous or unclear. Thus, trust can be a helpful tool to bridge uncertainty (Chrupala-Pniak et al., 2016). Subsequently, any 'trust gap' between community actors and external actors can exacerbate the feeling of suspicion and skepticism which has the tendency of stifling processes and strategies of building resilience. Trust may therefore be viewed as emotional engagement elements that create and embed environment and pro-environmental behaviours in norms and institutions (Brown et al., 2019), thereby fostering compliance to adaptation strategies for a sustainable future for all.

This chapter has set out to explore and understand the influence of trust in the processes of building resilience in drylands, especially critical in the study area, looking at the significant role of trust in communities' and individual's decisions to accept and implement resilience interventions. The chapter also examines how high levels of trust engenders high levels of individual and community engagement in activities in building a sustainable future for all. The chapter proceeds on how trust is framed as a social capital phenomenon within the study context, why it is important and what evidence is there to show for this. Then, linkages are drawn between trust and other identified principles and how these individually and collectively improves social-ecological resilience over time. The following section describes and presents the results of the data analysed and discussions.

6.3 Results and discussion

Based on the objectives and the research questions of the study, this chapter examines the significant role of the concept of trust in fostering commitment, engagement, and acceptance of decisions, conditions which in the end enhance implementation and success of interventions. The idea of intent-driven trust (see details in the introduction of this chapter) as a resilience principle is the focus of this chapter. It addresses the overarching aim of the thesis by assessing individual and community responses to environmental change in order to uncover the implications of underlying social-ecological principles to the building of resilience. This section presents the analysis and discussion of the data collected from the study communities, and to answer the three research questions of this thesis. Refer to chapter four for a detailed description on the methods and processes of data collection.

6.3.1 Changing environmental conditions

This section explores the changing environmental conditions of the study area in the past years.

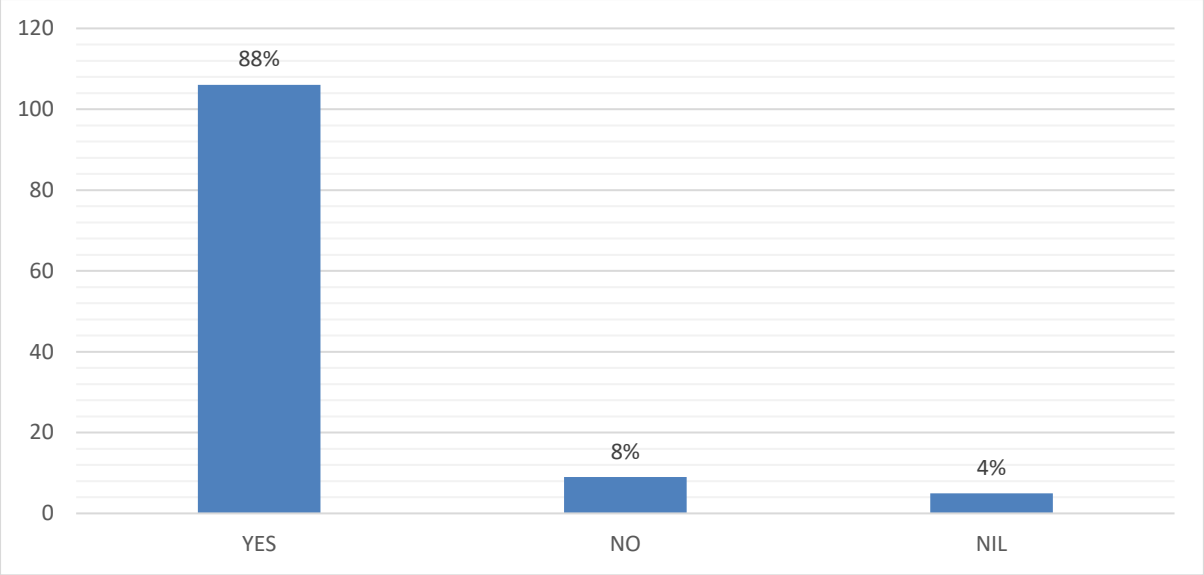


Figure 6.3: Perception of climate change in the last 30 years

Consistent with literature on changing environmental conditions in the semi-arid regions of Northern Ghana (Saito et al., 2018; Nyantakyi-Frimpong and Bezner-Kerr, 2015), about 88% of the respondents (n=106 out of 120) believed that the climate in the area has continued to change the last 30 years (see Figure 6.3), bringing with it dire economic and social impacts. This evidence signals the urgent need to develop and adopt strategies to sustain the livelihood of households and communities in the study area, as well as in regions with similar climatic conditions. These environmental conditions are predicted to increase and persist for a long time in the future by the IPCC (2014).

Consequently, any Climate change adaptation strategy to be adopted must look at the longer term by enhancing the capacity of individuals, households and communities to cope and also adapt to these changing conditions, while building resilience of their systems to climate change.

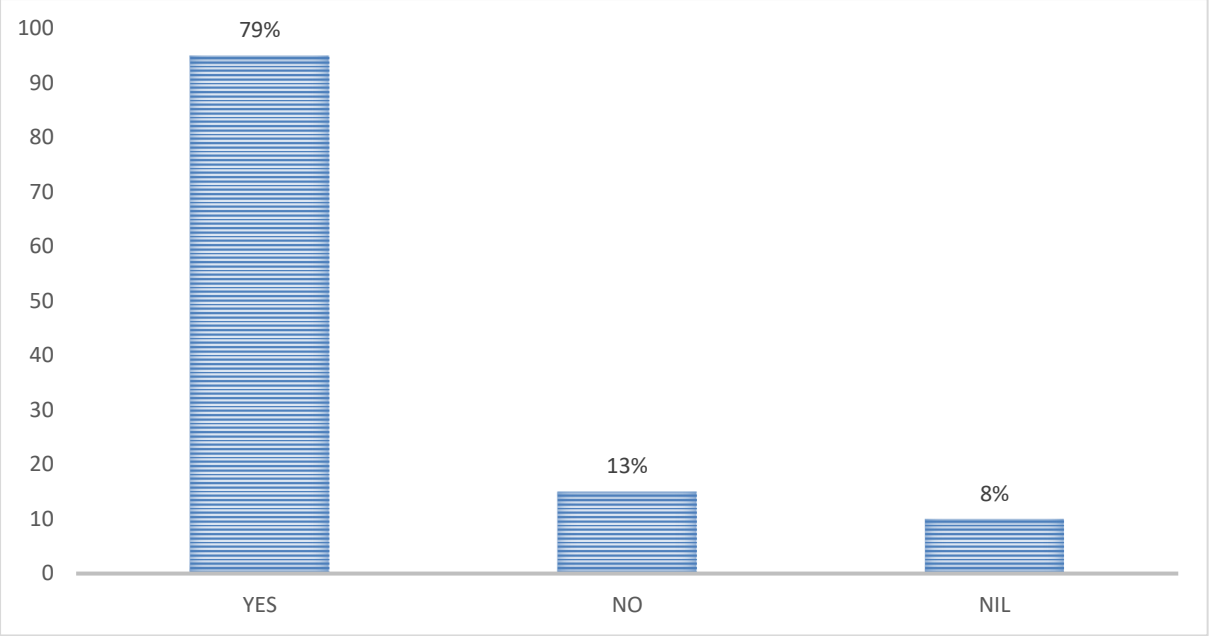


Figure 6.4: Perception of how rapid the climate is changing.

Figure 6.4 asks the question about the nature of the perceived changes in the climate in order to ascertain the extent of current impacts and how rapid they affect the people. Approximately 79% agreed that the climate is changing more rapidly than expected. Only 13% thought the climate is not changing rapidly, with 8% not responding either way. What is not clear about the last group of respondents is whether they did not believe the climate is changing at all or were unsure about the rapid nature of the change. Rapidly changing conditions in the area could signify that maintaining the status quo, which seems to have been the norm, is deleterious to livelihoods. And could also mean that interventions must be planned and implemented in short (mitigating immediate impacts), medium (monitoring and reviewing strategies) and long-term (building on existing and new strategies via innovations) basis, which require the active participation and involvement of communities and various stakeholders. Managing relationships between these actors to achieve desired outcomes is a fundamental necessity which can be possible if the role of trust is well understood and carefully applied for a sustainable societal acceptance of the operations of external partners especially.

Table 6.1: How drought is changing over the last 10 years

	Response	Percent
Increasing	**84**	**70**
Decreasing	**34**	**28**
No Change	**1**	**1**
Unanswered	**1**	**1**
Total	**120**	**100**

Figure 6.3 above shows 88% of respondents believe that the climate conditions in the area has changed over the last 30 years. Additionally, Figure 6.4 shows 79% of the respondents believed that the climate has been changing rapidly in recent times. When respondents were asked specifically about droughts, Table 6.1 reveals that 70% suggests that drought conditions are increasing, with 28% feeling it is rather decreasing, whereas 1% see no change. The results here are consistent with previous studies that were conducted in the Northern regions of Ghana where this study was done, that climate change conditions continue to affect livelihoods (Saito et al., 2018; Samaddar et al., 2018; Nyantakyi-Frimpong and Bezner-Kerr, 2015).

6.3.2 Developing trust through household participation: intra-household trust

As the conditions within which communities live and function experience dramatic changes, especially in dryland communities, elements of social capital as collective action through participation are crucial in order to engender transparency, build trust, enhance knowledge sharing and learning, and ensure legitimacy of decisions (Leitch et al., 2015; Jones and Clark, 2013). Achieving such nuanced combination of these elements in the society will help improve the adaptive capacity of social-ecological systems, thereby building resilience to the impacts of climate change. Leitch et al. (2015) refers to participation as the active engagement of relevant stakeholders in the management and governance process. It is through participation that relevant interactions and deliberations on appropriate resilience building strategies to adopt are made. Therefore, the role of participation and trust building are crucial mechanisms to increase the chance of understanding the dynamics of management system which will enhance

the capacity of the resilience building strategy to identify and address shocks and disturbances (Walker et al., 2002).

The nature of participation in terms of the level of engagement, and in which stakeholders are involved can influence its effectiveness. And at the household and community levels, who is involved, in what capacity and influence, can all be crucial considerations to address for effective strategy and subsequent desired outcome. Therefore, participation and trust between communities and external actors – district, regional and national political actors, NGOs - must be addressed appropriately. This ensure openness and clarity of intended outcomes which are necessary to build trust among stakeholders, but especially between community and agencies in order to enhance the likelihood of public acceptance of adaptation measures (Jones and Clark, 2013; Adger et al., 2009; Adger et al., 2005). But, the extent by which participation and trust can influence decisions and choices of strategies that support resilience of livelihood systems is central to this discussion and needs to be explored further. Participation processes may compromise ecosystem management if they do not have supportive social or institutional environment. In particular, participatory activities may be successful but will not build resilience if not nested within appropriate support systems where trust mediates and builds collective action necessary for public acceptance of climate change mitigation strategies (Leitch et al., 2015). Consequently, participation could help build legitimacy through the establishment of deliberative and supportive processes that are supportive and inclusive. This has the capability to enhance the building of trust and shared understanding as the basis for collective action, developing innovative solutions or fostering learning (Lebel et al., 2006).

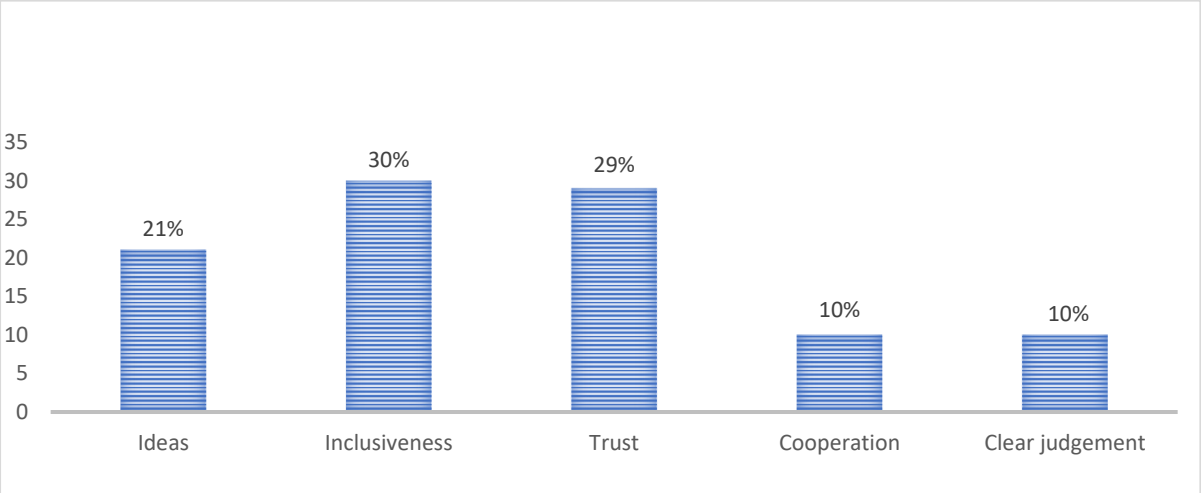


Figure 6.5: Possible ways in which participation in family decision-making enhances collective action.

Figure 6.5 above (N=90 out of 120 questionnaires) presents results on the question: In what ways does participation foster the building of trust among household members? Building of trust here refers to acts of strategically engaging household members in activities and decisions beneficial to everyone. Out of the 90 responses, 30% suggested that effective participation in household decision-making processes and activities improves inclusiveness, which creates the environment for new and fresh ideas (21%) to be incorporated to increase the capacity of households to mitigate against climate change. Figure 6.5 also shows that 29% of the respondents indicated that participation can build trust among household members and by extension, the community when appropriately applied. The building of trust therefore is likely to assure increased level of acceptance and openness, which are necessary bedrocks for climate change policies to succeed in communities. Perhaps, what is most needed is how to actively pursue and to create the necessary conditions to enable broader participation, especially from the marginalised groups such as women and the youth. On the other hand, as favourable conditions enable broader participation, conflicts are typical to surface, thus, avenues for mediation and redress must be instituted to take care of any conflicts that may arise thereof. As a participant in one of the individual in-depth interviews aptly stressed that togetherness within household and family members usually results in growth and strong unity bonds that fosters the capacity to cope and adapt to change. A respondent in one of the individual in-depth interviews puts it this way, that:

> *Effective family togetherness leads to growth, unity and strength (K_INTV_3).*

Also, community engagement to improve interpersonal relations must be encouraged, as pointed out by one community member in an individual interview:

> *Things that can be done to help people's lives in the community include faith in God, jobs, improved relationship between all members of the community (K_INTV_3).*

It is generally expected that as trust among household members increases, participation in decision making and other activities, as well as implementation of strategies should improve thereby favourably ensuring success of outcomes. Evidence from the survey data reveals the influence of improved and broad participation in household decisions on implementation of interventions and strategies. It shows that 51% believes improved participation can lead to acceptance and cooperation among household members, while 35% indicated it improves learning and advice, and 14% stated that it builds unity among members (N=104 of 120, 16 did not answer).

6.3.3 High levels of engagement and capacity building

The extent and nature of household participation, involvement and engagement contributes to capacity building, and also provide the potential to enhance trust.

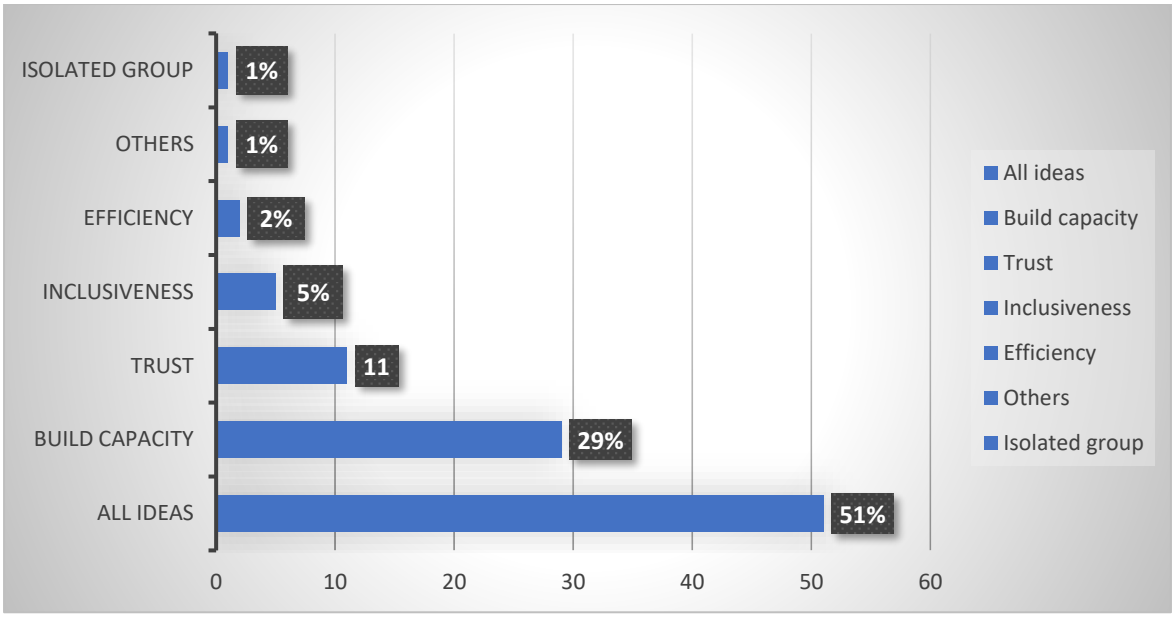


Figure 6.6: Ways in which high household engagement promotes capacity building

The study further asked respondents ways in which household engagement promote capacity building. Figure 6.6 (N=85) presents the results of 85 respondents out of 120 questionnaires. Answering the question, 51% indicated that high levels of engagements in the family and groups is likely to result in being able to assemble all relevant ideas that can be used to enhance the capacity of families to address climate change by building resilience. The other major benefit of fostering high engagement is its tendency to enhance confidence building (29%) to initiate and work with others to respond to variable climate conditions prevalent in the study communities. Trust (11%), which is a critical social capital element in facilitating acceptance, as well as inclusiveness (5%), where almost every member is represented in one way or another without restrictions, were also identified to result from high levels of household engagement.

6.3.4 The level of trust between community and external actors determines acceptance

This section examines how trust as an underlying principle governing peoples' decisions manifests between community and external actors when devising mitigation and adaptation strategies to climate change. It highlights the paradox of local people believing in certain mitigation measures such as tree planting (afforestation)(see Figure 6.7). However, permanent

activities on the land, including tree planting that infer land ownership intentions in the community are fiercely contested and frowned upon.

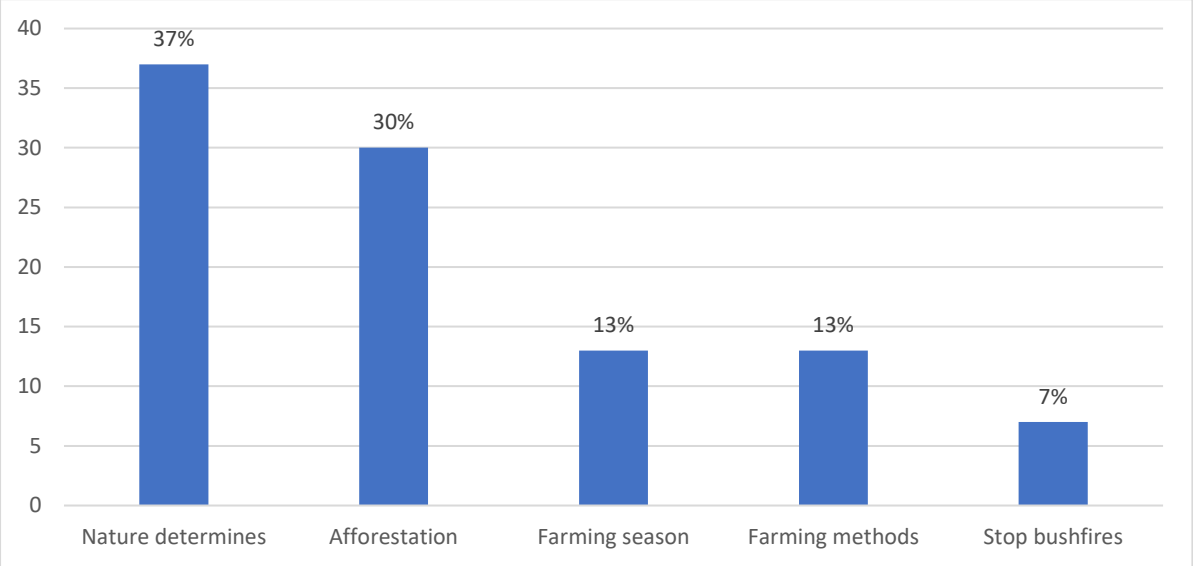


Figure 6.7: Strategies to mitigate impacts of climate change

It is evident from Figure 6.7 (N=54) that communities encourage tree planting as one of the major strategies for enhancing the capacity of the environment to respond to changes, with 30% of 54 respondents indicating afforestation as a climate change intervention. Though 37% of households surveyed alluded the fact that nature is the main orchestrator of the recurrent changes they continue to experience, they still expected support from government and NGOs as indicated in the interview response below. Extracts from interviews further highlights the call and need for external support in planting trees to protect the environment. One participant noted:

> *We need help and support from the NGOs and from government such as in planting trees, especially commercial tress like mango (K_INTV_3).*

However, traditional authorities seem to be weary of establishing permanent structures such as the planting of trees on lands obtained by individuals. The question of how interventions like tree planting can be implemented successfully in such communities requires an understanding of the influence of trust and goodwill between the people and other external stakeholders. Otherwise, communities may seem to embrace climate mitigation strategies only for the interventions to die prematurely thereby not achieving the desired goals set from the outset. For instance, one participant stated:

Environmentally, some tree planting has been initiated but has not fully caught on with all the community members. We frown on tendencies that show signs of ownership intent, which needs to be clear to build trust between parties(D_INTV_5).

The above statements highlight that apart from local dedication by communities, trust and goodwill of the intentions of external actors in such projects therefore can prove to be a critical factor in project survival and success in the long-term, which resilience enhancing interventions should require. As Schluter et al. (2015: 273) emphasise, "connecting diverse groups of people for a common purpose and encouraging the resolution of collective-action dilemmas is greatly facilitated by trust amongst participants". The discussion here goes beyond just the literal trust that is seen amongst stakeholders, but a rather nuanced form of trust born out of goodwill and understanding of underlining intentions of external bodies toward local partners interests, especially cultural and traditional values relating to custody of the ancestral land (Paul et al., 2016; Jones and Clark, 2013). Building trust with local communities from the outset, which can show genuine intention and interest in what matters and are important to the locals could bridge the gap and cause locals to favour climate change interventions. A women's focus group discussions rightly lamented the situation where interventions earmarked to alleviate hardship of women especially ends up in wrong hands instead, while the rightful beneficiaries continue to suffer under harsh conditions:

Government initiated a programme to support vulnerable families and especially widows. But they have not received any help from the scheme. What they know is that instead of support, it is other people who do not qualify for the support who make it on the list. (K_WM_FG)

Additionally, embodied within the concept of trust are the notions of acceptance, cooperation and collective action, necessary for mobilising community acceptance and support. When understood and utilised appropriately, these could enhance trust, which is likely to result in high levels of acceptance of projects and policies. Figure 6.2 modified from Moffat et al. (2016) for instance depicts that lack of intentional, quality engagement and fair treatment can reduce trust towards external actors thereby affecting the acceptance and support required for resilience strategies and policies to flourish and succeed. This condition was expressed by an elder in Kojokperi community regarding the establishment of the Gbele Game Reserve in the 1970s where the government of Ghana failed to engage fully with the community and also

reneged on its promises to construct dams and to develop alternative sources of income for the people since they could not enter the forest to hunt for wild animals. According to the elder:

> *Due to the lack of government engagement, we continue to flout policies and the youth especially most times resort to poaching which is not good. We would have even offered to volunteer to assist in managing the forest reserve should we have been consulted from the beginning (K_ELDER).*

Connectivity between actors facilitates learning as well as the sharing of information and knowledge as a result of high levels of trust and mutual understanding. But this can also lead to homogenisation of knowledge (Schluter et al., 2015) and hamper the building on of new knowledge and insights as important changes occur. Trust built on mutual understanding between actors, especially external parties thus becomes an important bridge upon which innovation and new insights needed to enhance the capacity of systems are forged, adapted and practicalized. Through trust learning goals are achieved, enduring collaborations are formed and translated, and therefore resilience strategies and projects are not unnecessarily inhibited, allowing for timely responses to change to be created. Subsequently, participation through mutual trust is a necessary condition which enables learning and other forms of transfer of new knowledge, insights and innovation to take place in the system. Crucially, it also helps to create the conducive environment for social learning to occur (Schluter et al., 2015).

Implementation of strategies and principles to respond to change whether planned or unplanned, almost always require that new capacities are created, and structures and processes changed (Ostrom, 2011). Consequently, there is the critical need to develop mutual relationships amongst individual actors, communities and external partners to achieve collective action necessary for smooth implementation where multiple perspectives and sources of knowledge operate. Increasing collaboration amongst a varied set of stakeholders as well as participation in processes of governance depend on a carefully crafted and accepted mutual trust existing among, and mediating relationships between relevant actors. It is therefore insightful as well as significant that social capital as an outcome of strong and mutual relationships, together with trust, provides the basis upon which to negotiate inevitable misunderstandings and mistrusts amongst stakeholders throughout the entire process of building responses to change. This is crucial in that it helps to provide the democratic space (Schluter et al., 2015) for negotiating inevitable trade-offs inherent with common resource management (Ostrom and Ahn, 2003).

6.3.5 Implications of trust and the building of resilience

Mistrust emerging from misunderstanding could seriously hamper the resilience processes toward change. This will help resolve the effect mistrust will have on implementation of resilience strategies and processes designed to build sustainable futures for communities. Although community involvement in projects can serve as an incentive to local people (Likoswe et al., 2018), achieving long-term and continued implementation requires a by-in from the people which the principle of trust can become the bridging point for sustainable community engagement. Goals and intentions must be clarified right from the outset and demonstrated. This calls for deliberative decision-making processes that intentionally seek to incorporate and foster adequate representation of local ideas, values and principles of multiple stakeholders, especially that of the local community (Rivers and Gibbs, 2011). Though, it might be impractical to incorporate all of societal values and aspirations at the same time under certain circumstances, considerable effort must be made to achieve greater consensus in good faith in order to obtain high levels of trust necessary for public acceptance and buy-in of climate change mitigation interventions.

Broadening consultation must be practiced, and any emerging new information must promptly be communicated, while addressing any emerging concerns as promptly as possible. This can help to create bonding, co-operation, belonging and unity among family members, as well as meeting needs. In order to build on more social capital via high quality engagement and trust, efforts must be made to identify key local community influencers besides traditional authorities to bring in so as to forestall any swaying of allegiances detrimental to progress of resilience project implementation. The factor of trust can be leveraged as a bridging concept with other themes to under-guide activities to improve resilience in drylands. There are implications of mistrust not just between actors, but also for resilience as a process, which must be studied carefully and drawn on for a more insightful contribution to building trust and capacity to mitigate climate change. Further investigation via existing literature into evidence of intra (among community members) and inter-trust (between community and external agencies) relations and formations amongst actors must be conducted to elicit the crucial dynamics of building fundamental trust needed to mediate acceptance and success of intervention programmes and activities.

But, migration to other parts of Ghana in search of economic opportunities from the area as an adaptation measure either as seasonal movement or permanent migration to avoid risks

(Thornton and Manasfi, 2010) can also affect the dynamics of education and training of the youth who form the bulk of those who move. The low literacy rate in the area is indicative of the fact that parents who are likely to struggle to educate their children may deem it a 'waste' of scarce resources, when at completion the children will migrate anyway due to lack of employment opportunities in the local economy are reluctant to send their children to school. Such movements therefore reduce the needed human capital, especially when the bulk of the number comprise the youth, which also disrupts social ties and networks to mobilize community collective action to respond to change. But, remittances from such migrations can be very useful in increasing family resources in capacity to adapt.

6.4 Summary

The findings in this chapter demonstrate that despite the relevance, potential or good intentions of any intervention designed to increase the capacity of communities to respond to changes, the building of trust through interactions borne over many years is an essential necessity for success in any activity or programme. People look beyond how good and relevant a project is, but place value on relationships, care and goodwill associated with projects. As Samaddar et al. (2018) point out, it is not enough for the relevance of the source of disaster preparedness information, but trust of, and show of care and concern, that are critical for acceptability. However, most interventions and strategies designed to help communities and individuals improve their condition and build on capacity usually adopt a top-down approach and much focused on methods and techniques to succeed without appropriate attention to sociocultural foundations, values and principles that embed peoples' decisions, choices and practices. But principles such trust are essential bedrock for acceptance, commitment and implementation of interventions, whilst driving success or failure of activities. The discussions in this chapter has therefore highlighted the role of the principle and idea of intent-driven trust as a significant resilience building element. The chapter suggests that intent-driven trust is needed between actors in order for resilience strategies in dryland communities to become effective and successful for the long-term. Consequently, trust of local people must not be overlooked but should be addressed as a matter of necessity in order to achieve full support and success of resilience project outcomes. This will allow for project design and implementation to occur in a bottom-up collaborative manner, resolving any local and context concerns throughout the life of interventions as and when they arise. Most important for building resilience, a bottom-up collaborative process ensures learning through experimentation, while reinforcing self-organising properties of the system to respond to future change. Trust particularly drives

change in behaviour, actions and focus, and will determine how far, and for what reasons, people will be willing to go with projects for its lifetime. Furthermore, it is evident from the study that participation, similar to engagement, could influence cooperation and collective action, which are crucial factors to enhance trust, learning, acceptance and monitoring and is likely to lead to improved resilience of ecosystems services. Therefore, insights about the dynamics of trust as an underlying principle are necessary to guide the processes of designing strategies and policies to build social-ecological resilience.

Women share the responsibility of providing for the home with the men, albeit, not proportionally. Although, there is no official information and evidence of the exact proportion of household contributions women provide in household upkeep in the District, it is estimated that they spend about 85 percent of their time on food processing and preparation for the family (FAO, 2011). This situation leads to considerable reduction in the time available to them to engage in home gardens and vegetable production, which usually form a major part of their main meal. They would need to use their scant resources to purchase from the market if they are unable to get from their own gardens. In spite of women's considerable involvement in catering for their families, coupled with the demands of societal norms to fulfill their marital obligations, major household and community decisions are taken by men with little or no input from women. The implications of this occurrence could be that women's concerns and interests may not be adequately served, which could result in the weakening of their capacity to respond to climate change impacts. From the foregoing, although men's contribution to their households is what is usually highlighted in the communities, the bulk of women's workload signals a gender-oriented assignment of tasks for men and women in the community. A condition that invariably creates different implications for men and women any time there are changes affecting the household or the environment.

Interestingly, there was no evidence of coordinated and planned effort to formulate community adaptation strategies in the study regardless of where one is located in the study area (Samaddar et al., 2014). However, irrespective of the lack of community engineered strategies, households and individuals have continued to adopt appropriate interventions to respond to climate change over the years. Measures such as livelihood diversification, out-migration etc, have continually been utilised at the household and individual levels. Consequently, community trust is needed for the mobilisation of local resources to address climate change. Additionally, there have been recurring seasons of plant pest (eg. army worm) invasion and animal diseases crossing borders from Burkina Faso that keep affecting farming. This helps to explain some of the transborder

interactions that occur in the study area and the attendant problems they help to create. It was however reported by the people that Agriculture Extension services that can help during such episodes mostly arrive when havoc has already been done. Another transborder interconnection in the Upper West Region is the effects of flooding resulting from the perennial opening of the Bagre dam at neighbouring Burkina Faso experienced by farmers (Abarike, et al., 2018). In view of this fluid interconnections across borders, deep insights about the idea of intent-driven trust in building collaboration between authorities of the two countries becomes necessary. In the nutshell, there is the need to build into climate change interventions the idea of intent-driven trust by anticipating and clarifying any uneasiness that may become obstructions in the course of delivering resilience strategies. Other community differences must also be accounted for in order to develop effective resilience strategies to enable communities to respond to climate change.

Chapter seven

The role of tradition, customs and religion in the implementation of resilience strategies

7.1 Introduction

This chapter addresses the first, second and third research questions of the thesis (RQ1: How do households and communities respond to the impacts of environmental stresses? RQ2: What key principles underlie peoples' responses to environmental changes, and why? RQ3: What evidence is there that these principles are socially and ecologically relevant in building resilience, whilst remaining relevant to the local people?). It argues that viable strategies and interventions are not enough in themselves to address risks and changes, especially in the areas of acceptance, implementation, evaluation and succession which are necessary to ensure the resilience of systems. This thesis stresses that decision making by most local actors is underpinned by socio-cultural principles, and these determine to a large extent what people decide to choose as important in responding to change. How society perceives available interventions and whether they will adopt, integrate and sustain such interventions for building resilience, is also governed by these sociocultural principles. Insights of the operations of these principles are therefore useful in designing and implementing adaptation strategies. Sustainability of natural resources in harsh environments like drylands has continued to be a necessity in the face of increasing climate change conditions. Building resilience of communities that heavily depend on natural resources must be a priority to any society. Effective adaptation strategies must be developed, in connection with local context conditions in order to support their operations. Building resilience requires strategies that are locally appropriate. Many local practices rooted in cultural or religious traditions can help devise such strategies. Because religious and traditional beliefs and practices take different forms and expressions in different communities, the success of incorporating ideas from tradition and religion into developing resilience strategies depends on the prevailing location socio-political context (Newsham and Bhagwat., 2016).

Some scholars have highlighted in their works that community co-operation towards collective action is made possible through social capital, as some of its attributes such as trust, norms, values and networks possess the capabilities to generate expectations which serve as incentives to facilitate actions and punish non-compliance (Ostrom and Ahn, 2003). However, others like

Olson (1965) viewed co-operation to mainly result from material incentives and coercion, absence of which could obstruct co-operation. Uphoff (2000) on the other hand proposed that co-operation is motivated by norms, values, beliefs and attitudes that create expectations rather than through material incentives. Based on this background, this chapter of the thesis sets to explore the role traditional values and customs play with regards to how people respond and make choices including natural resource management. Moreover, strategies that can be adopted to respond to environmental change are to some extent guided by moral and ethical values derived from religious and traditional connections. It is in this same respect that Newsham and Bhagwat (2016) in their study of how faith groups could become crucial partners for conservation and development ventures, highlighted how conservation and development are driven by moral and ethical values. These are crucial values that could be factored into strategies designed to building resilience of local communities' livelihood systems. This chapter is designed to investigate and analyse the role of socio-cultural and traditional values underlying choices and strategies in response to climate change. To achieve this, a description of the major responses adopted by individuals and households to mitigate climate variabilities (especially drought) with a focus on how traditional and cultural values influence decisions was conducted.

A host of exogenous factors (international and national policies, international market, laws) contribute to how strategies are framed and used to address changing conditions. However, local factors play a significant underlining role to decisions, choices and interventions people develop over time to mitigate climate variabilities. Such factors include the role of religion tradition and culture, which is the focus of this chapter and it is analysed in relation to other such embedded principles in making choices to respond to change and build social-ecological resilience. Furthermore, most analysis of responses to changing conditions put premium on climate unpredictability and other more prominent exogenous factors for analysis against traditional and cultural values that embed decisions and choices people make (Bruijn and Dijk, 2004). For instance, issues of trade-off between ecosystem services and strategies that can be adopted to respond to environmental change has continued to be pronounced in recent times (Chapin et al., 2009). Prioritising one bundle of ecosystem services against others may be directly opposed and therefore should have a wider benefit for a larger group of people and communities. However, culture and tradition of a group of people, as well as the kind of prevailing worldview have the potential to exacerbate such differences and conflicts (Schoon et al., 2015). Without addressing the cultural dimensions of the trade-offs, it becomes difficult

to build the consensus highly needed for society to find common grounds to develop long-term strategies whereby society collectively lives within appreciable limits for sustainable development. However, as discussed in the previous two chapters, certain adopted principles by communities to respond to change through decision-making and choices have not been widely studied and understood. Chapter five of this thesis explored the essential need of NTFPs in the community's life, but pointed out the need to understand cultural identity as an underlying principle and condition for people's actions and choices when planning on expanding and commercialising NTFPs. In the same manner, chapter six examined the influence of the principle of trust as a significant factor to enhancing social capital that could eventually determine acceptance or rejection of adaptation strategies from external actors to address climate change and resource management.

This chapter follows up to explore the role of religion, traditional values and customs in developing and supporting strategies to build resilience in communities as a response to the harsh impacts of climate change. Drawing on a mixed method case study approach (see Chapter 4), the chapter examines how the belief in tradition, religion and respect for the elders underpin and direct choices that could determine what strategies to adopt and align with. Addressing the aim of this thesis of understanding the key underlying principles relevant to dryland dwellers for building resilience, this chapter, guided by the theoretical framework and the research questions, attempts to answer the following specific questions:

- To what extent do local traditions and customs have an influence on people's choices and decisions?
- What benefits and or challenges can exist when communities make choices to build resilience on the basis of traditional values and religion?

The chapter progresses with a description of the theoretical standpoint relating to culture, tradition and religious influence on resilience. These are anchored within the concept of traditional ecological knowledge, unpacking the aspects of TEK that affect day to day living of individuals and households and the choices they make. This is followed by the data analysis and discussion section, and the chapter ends with a summary of the key findings and recommendations.

7.2 Theoretical framework

Societies' internal dynamics through religion, traditions and culture shape their responses and association with the natural environment they dwell in. And it is significant to understand the

kinds of worldviews those societies have about nature and how natural resources should be managed (Arizpe et al., 1998). These traditional religious customs and rituals are sometimes framed and studied within the conceptualisation of the notion of traditional ecological knowledge (Boafo et al., 2016b), which this chapter adopts. Building resilience needs locally-appropriate strategies. But with TEK rooted in cultural traditions, understanding and incorporating TEK attributes could boost local acceptance to strategies to develop resilience. This chapter examines the practices of a rural community in northern Ghana in relation to other categories of TEK identified in similar studies to unpack the effect of prevailing characteristics of TEK and how these can be applied in resilience policies.

7.2.1 Significance of culture, traditional values and religious beliefs and resilience

Religious beliefs and traditional values people hold are very complex in nature, which makes analysing the role these play in perceiving and choosing strategies to manage environmental resources, building resilience for sustainability, also a complex exercise. Generally, beliefs, values and practices that people hold in whatever form it takes can both be shared and individual, informed through experiences, indoctrination and socialisation. They can also be consciously or unconsciously held, and may manifest in all kinds of behaviours, rituals and cultural practices (Saito et al., 2018, Boafo et al., 2016a).

However, traditional ecological knowledge is seen to manifest in all areas of local day to day living, rituals and cultural practices of communities. Boafo et al. (2016b) in their research on the role of TEK in northern Ghana reported how the TEK applications manifest in daily, seasonal, periodic and temporal livelihood activities, such as from farming systems, collection of wild food, and to the performance of rituals and ceremonies. Generally, it is these traditions and religious practices that under guide people and community choices and or, their disposition to adopt or reject strategies that scientifically have the potential to help combat climate change. Invariably, strategies that seem to align with local traditional practices are likely to be favoured by applying them to respond to climate change and build resilience of their livelihood systems.

Major areas of community life where traditions and customs and ritual ceremonies manifest fall into four broad categories as presented in Boafo et al. (2016b) work on TEK:

- Taboos and totems: No killing of totemic animals and plants. E.g., crocodiles; no cutting down of trees; no entry to sacred shrines; no fishing/farming on certain days (Tuesdays and Fridays respectively).

- Customs and rituals: Rainmaker ceremonies; using of natural resource materials during birth and death, and to consecrate chiefs; chasing famine; traditional medicine; festivals to celebrate planting and harvesting seasons.
- Rules and regulations: No harvest of natural resources on a person's farm without their permission; seek permission from chief before farming land; build fire belts around farms to prevent bush fires; no hunting pregnant animals.
- Traditional protected areas: Sacred forests/groves, shrines; woodlot, water points; rice valleys; river banks.

All the TEK categories mentioned function in connection with each other and therefore could be looked at in holistic manner. Each must be treated as a part of the whole, affecting and being affected by the others. However, Boafo et al. (2016b) in their study identified the influence of demography on prioritising the use and application of TEK. They found that young adults in the study highly preferred rules and regulations to any other form of TEK application. This could be explained as a sign of young adults frowning or disassociating themselves from traditional practices that they may feel are more primitive and have to change. But, adults may deem such behaviour an affront to their culture and therefore might attract repercussions from the gods. Mature adults in the study on the other hand, prioritised TEK protected areas using customs and rituals, while offering moderate rating for taboos and totems. Similarly, the elderly in the communities also gave traditional protected areas a priority rating. This could point to the inclination of mature adults and the elderly on the need to adhere to rituals and customs in order not to incur the wrath and punishment from the gods and ancestors.

Significantly, highly dependent communities on provisioning ecosystem services largely recognise the role of TEK as a practical measure of sustainably managing limited natural resources, especially in the face of environmental change (Boafo et al., 2014). Some research results point to the social and economic contribution of TEK in ensuring that productivity and sustainability of ecosystem services are maintained (Boafo et al., 2016a; Boafo et al., 2016b). Subsequently, TEK is framed in this study as the principle of traditional and religious values that underlie decisions, choices and strategies of individuals and communities to respond to environmental change by building resilience of fragile ecosystems like drylands. In doing so, the thesis explores the influence of respect of traditional authority as the embodiment of the will of the gods and ancestors and therefore must be revered and obeyed thereby receiving the blessings, not curses, from the gods to prosper.

7.2.2 Respect of traditional values as significant resilience principle

Respect for tradition and customs informs what individuals and communities can or cannot do. For example, one has to seek permission from chief before farming land in some communities. This principle therefore underlies how the society will choose to align with strategies that are developed to respond to climate change. Most taboos instituted are used as measures to check over-harvesting and to manage natural resource levels, and sometimes to curtail conflicts. This helps to restore endangered animal and plant species. Account of hunter informants in a study continue to highlight the taboos not to hunt and kill different types of animal under certain circumstances such as being pregnant (Boafo et al., 2014). This same condition works regarding collection of wild plants for specific purposes. Breaking or violating such taboos will require sacrifices to appease the gods and the ancestors, and failure to fulfil the sacrifices could result in barrenness in the case of women or being bitten by an invincible snake.

Local informal, but generally agreed, rules and regulations which are usually underlined by traditions and customs play critical role in community livelihoods by directing and guiding behaviours and actions of people. These rules are used to facilitate choices around particular ecosystem use or non-use informed by their present conditions impacted by environmental change. Importantly, these rules and regulations are grounded on the respect and authority of traditional rules and elders (Boafo et al., 2016b) which helps to understand the role of respect of authority and its influence on choices of strategies to build resilience and respond to climate change. With these rules come sanctions and levies when there are violations by individuals and households. Invariably, non-compliance to such rules and regulations could result in fines, public flogging or even expulsion from the village on extreme cases (Boafo et al., 2016b).

Other forms of TEK that are widely studied and understood have been through the concept of Protected Areas. These areas are particularly set apart and protected from use and sometimes, abuse by the community based on their special contribution and significance in the economic, social, cultural and environmental well-being of the people (Bhagwat et al., 2014). Protected areas mostly consist of sacred groves, fallow lands, woodlots, riverbanks, and they are believed to be the habitat of the ancestors, gods and other spiritual entities of importance to the community (Saito et al., 2018; Bhagwat et al., 2014). Over time, conditions of the ecosystem in these protected areas are found to have improved considerably, affecting all related areas of the livelihood systems of the local communities (Boakye-Danquah et al., 2014).

7.3 Results and discussion

The results of the study reveal that religious and traditional practices play significant roles in the livelihood activities of individuals and households. The extent of the influence of traditions, customs and religion is dependent on the respect the people accord to traditional chiefs and authorities as the representatives of the ancestors. The results were analysed in the context of the four categories of TEK presented by Boafo et al. (2016b), highlighting similarities and differences. This chapter reveals and highlights traditions and cultural practices as significant resilience principles as RQ2 and RQ3 have sought to untangle (see chapter 1).

7.3.1 Religious beliefs, tradition and resource use dynamics

Traditional religious practices and custom have variously been identified to play key roles in local community daily living processes (Haider et al., 2019; Bhagwat et al., 2014). Such practices as taboos, prohibitions to sacred places and rituals, generally govern peoples' choices and decisions, most often directing where certain livelihood activities like farming could be allocated. This section explores some of traditions' influences the decisions and choices people make in the study area.

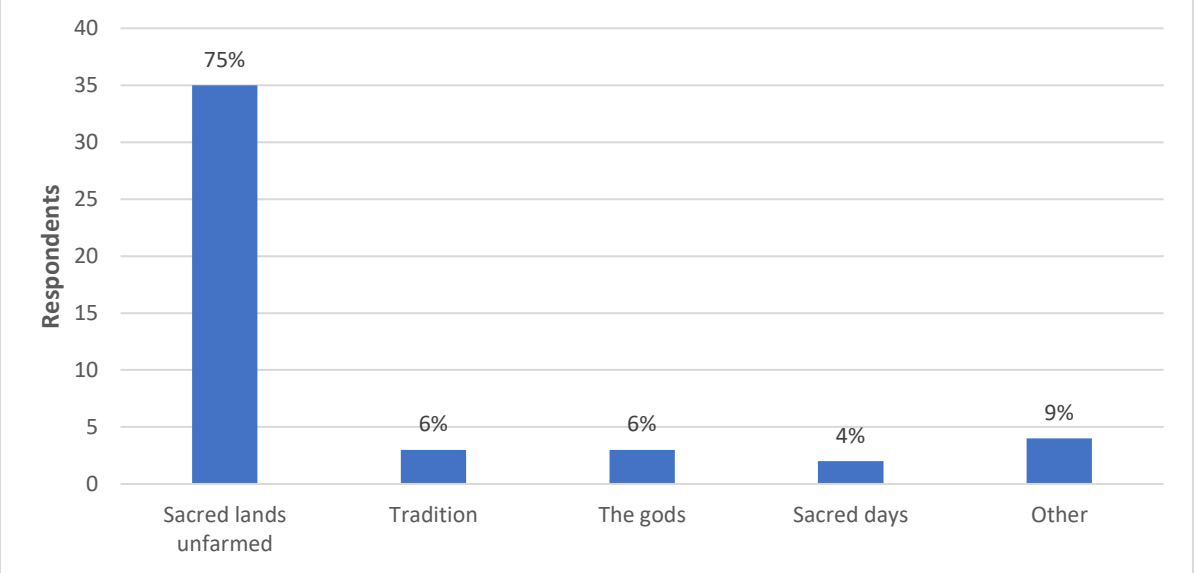


Figure 7.1: Perceived influence of tradition and customs on the location of farmland.

Various traditional and religious practices play significant roles in determining how certain livelihood activities operate in the communities. As evident in Figure 7.1, majority of the 47 respondents who answered the question on how tradition and religious practices can influence where an individual can or cannot farm indicated that sacred lands as determined by tradition cannot be farmed had a greater impact (75%). This result is supported by Boafo et al. (2016b) who also identified in their study that traditionally protected areas such as shrines, sacred forests were strongly adhered to in order not to attract the vengeance and punishment of the gods.

Qualitative interviews revealed that other practices identified to have influence on appropriate strategies that could be adopted to curb the effects of climate change include tradition and customs which play out as decisions by the gods, and sacred days where certain activities will not be permitted to be done. Additionally, similar views of the power of deities and gods to influence the course of social and economic activities of individuals and households were echoed by respondents. One individual said during the in-depth interview that:

> *Fishing used to be forbidden from our main river near to the Fiansi area because it is believed when the fishes are taken, the 'power 'of the river is also taken (K_INTV_3).*

It can be deduced from the above response that the rule forbidding fishing in the main community river seem to be losing its influence because of the words 'used to', suggesting that fishing is likely to be occurring now in the community, albeit secretly. This indicates a departure from Boafo et al.'s (2016b) work which saw a strong adherence to such rules. This possibly also signals the depreciation of how people hold such traditional practices in the study communities. Most probably people may not be obeying the rules because they are no longer afraid of the repercussions and punishments, they and their families are likely to suffer from the gods. However, such changes might not necessary be as a result of repercussions, but probably due to religion and tradition becoming flexible and adaptable so could operate in alternative pathways. For example, Haider et al. (2019) in their study of the effects of development on biocultural diversity in the mountains of Pamir in Central Asia found that while one community adhered to traditional practices and fostered biocultural diversity, the other performed rituals with replaced store-bought items signalling some sort of cultural erosion or adjustment. Conversely, sacred and reserved lands can be used for farming and other 'light' developmental activities under certain circumstances and only when the 'Tindana' (the

Land owner) would have performed some rituals to appease the gods and ask for their permission. This was confirmed in the key informant interview with a Tindana who said:

> *It is possible to farm on the 'reserved' land but cannot develop it for any permanent activity without permission from the Tindanas who will perform some rituals before being able to release any portion of the land (K_Tindana).*

The reserved lands here refer to sacred lands reserved for families to use as and when specific needs arise, and only when the necessary rites are performed. These custom and ritual practices present implications to the implementation of strategies to mitigate and adapt to climate change impacts, and to increase the resilience of the SES of local communities. It is therefore important to increase understanding on the dynamics of these practices in order to appreciate and recognise their potential of undermining or jeopardising policies and strategies. This can afford the chance to design and implement resilience strategies incorporating insights likely to foster cooperation amongst actors and increase community acceptance.

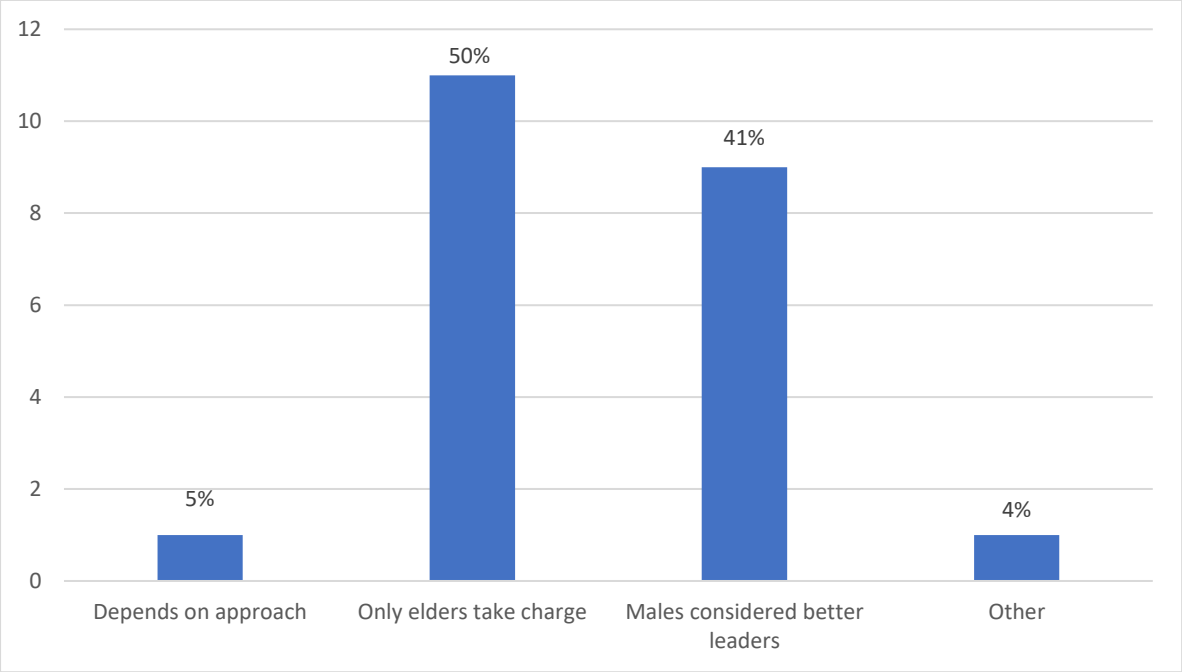


Figure 7.2: Dynamics of household decision-making and choices

Various demographic structures backed by indigenous unwritten rules and regulations are shown to determine who holds what level of influence in family and household decision-making. It is clear from Figure 7.2 (N=22) that elders (50%) and males (41%) are preferred to lead in decision making. Such scenarios also play out at the community level where the

authority of the chiefs and elders are almost always upheld against every other groups in society, entrenching the historical patriarchy influences in that part of northern Ghana. In one token this seems to be a good thing for progressive development of the community when it is mainly the chiefs and elders who encourage behaviour change, as elucidated by a statement from one of the men's FGDs below:

> *Traditional elders and chiefs strongly encourage behaviour change through their customs and traditions. They also educate the people on the benefits and how to promote such in their individual families (K_MEN_FGD).*

However, prevalence of decision-making being the preserve mostly of the chiefs and elders could significantly stifle innovative ideas from marginalised groups such as women and the youth. There is the need to constructively engage with all other social groups in order to gain broad-based strategies in curbing climate change.

Figure 7.3: Family shrine where libation is offered to the ancestors to seek their support in times of need.

Families usually resort to various traditional and religious rituals when they face challenges in a bid to seek for the assistance of the spirits, including the ancestors. It is the belief in such practices over long periods of time, which underlie prevailing worldviews that hold potential to determine choices and decisions of individuals and households. Consequently, developing policy frameworks to respond to climate change should decipher and incorporate facets of belief systems entrenched in the day to day living of local people. Figure 7.3 for example is a family shrine and the members are believed to be connected through their ancestry and

therefore could offer sacrifices, pour out libation and solicit for help from the spirits of their forefathers. Families could approach such shrines and ask for rain in times of severe droughts. An interviewee stressed the significant role of religion in the lives of the people, which is dwindling nowadays with detrimental effects:

> *Religion has been key, but nowadays people don't practice their faiths. When religion is made a major part of our lives, we can still have togetherness (K_INTV_3).*

7.3.2 Implications of traditional values and religion on resilience

Traditions and customs are key principles that could play crucial roles in influencing processes of building resilience. Thus, studies into how these may undermine or promote social-ecological resilience in drylands could produce useful insights for practitioners and scientists. For instance, one of the study communities derived its name from a stone locally called 'kojokperi', which literally means, 'covered the stone'. In the past whenever it used not to rain the elders will go to the stone and perform some rituals in order for it to rain, and it will usually rain the same day after the rituals. This occurrence has changed in recent years to the extent that it does not matter the number of rituals performed at this same tone, it will not rain. The situation is so nowadays possibly because of the breaking of the taboos, such that women in their menstrual cycle were not permitted on around certain radius to the stone which is not strictly adhered to now. Also, people were not allowed to be seen in the market grounds at night. The current situation has deteriorated to this point because, in the past the elders put 'fear' into people to frighten them to obey the taboos or face dire consequences, and it worked fully (K_INTV_3). Invariably, people choices and decisions may not be devoid of the influence of one or more of the prevailing traditional practices and rituals such as displayed in Table 7.1, which could in effect, jeopardise the prospects of hitherto promising resilience projects. Therefore, designing adaptation measures and other strategies to implement to improve the resilience of livelihood systems, must be framed with prevailing traditional practices in mind. Efforts must be made to understand the effects of these practices and how to harness their power to boost the implementation of resilience projects in the long-term.

Table 7.1: Manifestations of TEK and traditions and customs in study communities after Boafo et al. (2016b:29) framework.

Categories in Boafo et al (2016b:29)	Manifestations in present study
1. Taboos and totems	• Forbidden to kill crocodiles in village pond as totem of the people. • Fishing is forbidden in some rivers (K_INTV_3).
2. Customs and rituals	• Family rituals to ancestors in times of difficulties (Figure 7.3). • Appeasing the kojokperi stone for rains (Sub section 7.3.2).
3. Rules and regulations	• Requirement for permit to access forest reserve.
4. Traditional protected areas	• Sacred lands (Figure 7.1). • Gbele forest reserve.

This study has highlighted that there are deep social and political aspects that should be considered when developing strategies to respond to the changes. The repercussions and implications of the current situation of climate change impacts on ecosystem services and the potential of destabilising the system of local communities' livelihoods, could highly be accentuated when the people feel disenfranchised on traditional and cultural grounds. One of the clear issues emerging from this research is the significance of examining the influence of socio-cultural factors that under guide specific decisions and choices of individuals and households in responding to the impacts of climate variabilities (Dietz et al., 2004). Most especially, it is imperative to disentangle these underlying traditional and cultural variables informing peoples choices and responses to change. For instance, people believe in the power of God and spirits to help provide their needs. To the people, droughts and other forms environmental changes are seen as the acts of God (Robinson and Berkes, 2010). Such beliefs must be explored in order to understand what principles drive decisions and are likely to influence acceptance or rejection of certain resilience strategies that may be viable scientifically. The statement below clearly captures the strong belief the people hold of provision from God and invariably their smaller gods and ancestors in resolving their needs:

Things that can be done to help people's lives include God through faith, jobs, improved relationship between all members of the community (K_INTV_3).

Generally, community rules, regulations and customs and traditions are adhered to and respected. So, such principles will be applied in all strategies to prepare for future changes. For example, when the dugout was constructed in Kojokperi, the Tindana and his team went to the site and declared that no one should ever do any fishing in it and it has stood till date (K-Tindana). The influence of tradition was so strong much so that even the person who sees wrongdoing and fails to report to the appropriate authorities could face consequences. Specifically, according to established beliefs, a snake could bite both culprit and witness who fails to report wrongdoing, and both will die as a result.

An example of how established informal rules and regulations play out in the study community's life where decisions and choices are underlined and directed by socio-cultural practices can be seen in the case of succession to the position Tindana should one become vacant. The process is usually adhered to without any dispute as a result of strict recognition of established folklores that state that the position will automatically be passed to the next eldest male of the family, except he be declared invalid due to some serious breaches against the spirits or problems with sanity. This indicates a clear evidence of the study community adhering to rules and regulations set out and instituted by their ancestors similar to the findings in Boafo et al.'s (2016b) where rules and regulations regarding harvesting of natural resources in another person's field is forbidden unless permission is given beforehand by the owner. These rules and regulations over time become engrained in the everyday life activities of the people, becoming unwritten as well as 'unseen' (Wong, 2007) principles that underlie decisions, almost are non-negotiables in the society. One of the key informants interviewed corroborated the succession process story in the statement below:

The succession to the position of the Tindana is passed on undisputed to the most senior elder in the family with sound mind. No arguments as to who becomes the next Tindana, it has always been clear at the time (K_Tindana).

Subsequently, it is the understanding of such underlying principles of rules, regulations and rituals, written and or unwritten, that this chapter argues are crucial when it comes to developing resilience related strategies as responses to general environmental change, but climate change in particular. Policymakers and scholars would have to untangle and pay attention to the origins of these cultural formulations, how they have evolved over time, who

guides and controls their existence, how the society perceive and adhere to the practices, and whether there are subtle differences between believing in, and practicing of the cultural and religious edicts. Haluza-DeLay (2014) for example found that cultures and religions can be somewhat flexible to adapt to new changes when there are subtle differences in what people believe in and what they actually practice.

Anecdotal information through informal discussions with some key members of the study community generally seemed to highlight the fact that the community strongly believes in, and attaches importance to traditional and cultural practices in all facets of their lives. Consequently, this study has shed light on the nature of community bond to tradition and culture in their livelihood activities which requires that policies and strategies be drawn understanding and incorporating these principles in improving their capacities and building social-ecological resilience to respond to the recurrent environmental changes.

7.4 Summary

The chapter has explored how the values of the society toward nature is expressed culturally. The discussions in the chapter has focused on the idea that resilience has more to do than just policies. Local conditions such as tradition and culture mostly drive actions and must be taking into account for policies and interventions to be effective. Thus, climate change adaptation strategies must be designed in a culturally-sensitive manner and implemented. Society has obligation to, and rights over nature, but most often it is the adherence to some sort of belief system connected to nature that underlie and inform decisions and choices. Ancestral spiritual beliefs for example do influence and support local people to continue to conserve natural resources (Chunhabunyatip et al., 2018). Traditional religious beliefs are interconnected and complex thereby fostering complex networks as well. These networks of belief and value systems manifesting within TEK could give agency, whilst making people under-emphasise their vulnerabilities but determined to promote resilience processes. Understanding and appropriating certain beliefs could also facilitate support for, and or mobilise legitimacy for resilience related processes. The study has shown that nature is largely for society to continue to protect and use according to prevailing traditions and customs. But the question of whether current economic necessities are a stronger force governing cultural behaviour choices toward nature in the face of harsh conditions of living requires further investigation to increase understanding. Religious and traditional authority of community leaders and elders, though under threat presently, should strategically be engaged with in responding to climate change (Keys et al., 2016). Policy makers and other key actors must engage with local traditional

beliefs, values and knowledge, applying insights from them in order to achieve sustainability through the consistent strengthening of resilience processes, consistent with the desire of this thesis to uncover resilience principles and to answer the three research questions. Such beliefs must be recognised in official circles and incorporated in resilience strategies.

It seems evident from some of the narratives that there is emerging degree of flexibility in application of religious beliefs and other practices, such that local communities still believing in the old ways can adapt to new ideas and conditions (Haluza-DeLay, 2014). Consequently, this aspect of religious dynamism could provide the platform for developing appropriate and effective resilience related strategies to mitigate and adapt to climate change, whilst building sustainable futures, especially for deprived communities in dryland ecosystems. This notion of emerging religious flexibility somehow alleges that religion is largely practiced than just believed (Haluza-DeLay, 2014), therefore, there is the need to target the practice of religion rituals for effective and workable approaches to respond to the impacts of climate change, whilst improving resilience processes. However, more scrutiny needs to be carried out in the area of targeting the practice of, and the power possessed by religious and traditional values to moderate behaviour change. As the study has shown regarding the current tendency of some community members not performing their religious and traditional obligations as they ought to, according to traditional rules and regulations (see results section).

The District has a youthful and growing population, but high illiteracy levels which is starker in the east, likely due to the lack of Senior High Schools for progression when Junior High School students complete their studies. This condition is seen as one of the factors that forces the youth who could stay back and contribute to community develop, to out-migrate to mostly to Southern parts of Ghana looking for better economic opportunities. The main reason proffered by these people who migrate is to obtain income and resources in order to remit home for the upkeep of their families. This situation is exacerbated by the recurring effects of climate change which continue to shrink natural resources and farming opportunities causing the youth to migrate as a means of responding to climate change. Widespread anecdotal information in the District suggests the youth migrate to the southern parts of Ghana in search of high paying jobs and also to engage in small-scale illegal mining, popularly called ‘galamsey’ (Ghana Statistical Services, 2014). Mostly aged between 18 and 35, the youth are normally tempted by the affluence displayed by the few who are able to return. The returnees are usually seen as having prospered by the luxurious items they bring with them, and are able to afford things largely beyond the economic reach of a normal local youth.

However, stories have it that these migrations are full of uncertainties with some people ending up to lose their lives in the process. Additionally, most of the youth return with new behaviours and habits that the elders view as affront to the culture and norms of the communities. Some end up joining armed robbery gangs and indulging in all sorts of antisocial vices. The most disturbing trend about these out-migrations to the elders, is the tendency of returnees abandoning their local cultures and traditions. They seem not to partake in most of the household and community instituted rituals, claiming that they have become 'civilised' and now see such practices as archaic and must be discarded. Subsequently, the intrusion of the tendency of not strictly adhering to cultural practices has been cited as one of the main reasons for the persistence of climate change as the gods may not be protecting and providing for them as they ought to. They even fear that climate change is a form of punishment from the gods and ancestors.

To formulate socially and culturally implementable local climate change interventions, efforts must be geared toward developing traditionally friendly alternative interventions focused on women and the youth. This can be achieved by engaging religious and traditional leaders to assist in devising such alternatives. The foregoing brings to the fore the significance of the notion of 'intent-driven trust' discussed in chapter six, to guide actors in resilience projects to always act in good faith to benefit the local community they serve, such that local communities will become confident that their traditions and customs will not be undermined.

The next chapter presents the overall discussions running through the entire thesis, as well as the conclusions and recommendations for policy considerations.

Chapter eight

General discussion and conclusions

8.1 Chapter overview

This chapter provides a synthesis of the discussion of the key findings of this thesis in respect of the overarching research question of analysing the underlying principles of adaptation strategies to climate change in drylands, and what households and individuals perceive as relevant and sustainable. It proceeds with a general discussion of key findings and sets out major conclusions and recommendations and suggests areas for further research. Section 8.3 discusses the answer to the second research question that seeks to identify and understand the principles that underlie responses and choices of the people to change, and how these are ecologically relevant in improving their adaptive capacity thereby building resilience to change. Section 8.3 summarises findings to the third research question which compares and contrasts the local adaptation principles to literature, and Wong's (2007) agency-institution-structure framework, to reflect and highlight how resilience is characterised in drylands. Collectively diverse livelihood options by way of NTFPs (see Chapter 5), trust-based institutions (see Chapter 6), cultural underpinnings of peoples' ability to deal with environmental shocks in wider religious and traditional contexts (see Chapter 7) contribute to building social-ecological resilience.

8.2 General discussion

The ultimate aim of this thesis has been to assess individual and community responses to, and outcomes of change to help uncover what social-ecological principles underlie responses to environmental change. The study also assessed the general resilience of individuals and communities against recurrent and escalating events (disturbances) via the lens of the social-ecological system conceptualisation. Furthermore, it promotes the streamlining and mainstreaming of ideas, innovations and strategies for improving conditions for sustainable livelihood of vulnerable dryland dwellers, through highlighting complex adaptive system thinking, capacity building, learning and innovations, increased participation, co-operation and networks. Consequently, it attempts to distil indigenous experiences and knowledge, and other actor-space interactions into viable strategies for building social-ecological resilience in dryland ecosystems.

The overarching research question of this thesis has been to understand the embedded socially and ecologically relevant 'principles' that have been learned and used over the years by indigenous people, which hold possibility to enhance the building of social-ecological resilience in drylands as a response to rapidly changing conditions. In the light of this, the research has attempted to answer the question suggesting that the adaptive capacity of local communities to respond to environmental changes and to build resilience over time can be maximized by understanding how households and communities perceive and value their relationship with their natural environment and resources. Most of such high environmentally dependent communities have socially unwritten rules and principles that underlie daily livelihood activities and choices (Haluza-DeLay, 2014) which have to be examined and harnessed to improve their capacity to adapt to change and to build social-ecological resilience over time. A major implication of misaligning or omitting such principles when devising resilience strategies could result in the lack of support from the people, with the potential of jeopardising resilience programmes. Learning from the experiences of the people in dealing with persistent changing conditions and disentangling the motivations and factors that inform their choices and decisions could go a long way to help scholars and practitioners to devise and implement generally acceptable measures to deal with climate change in the long-term.

As Engle (2011) highlights, the past is just not an inconsequential episode that has not much to offer. Instead, there are much important lessons that can be examined to unearth sociocultural mechanisms and principles, and experiences that can facilitate adaptation and to enhance resilience strategies. Analyses of the contribution of past experiences of communities that continue to experience dramatic changes and forced to develop ways to respond to present change and adapt to future threats is useful. These require in-depth study to disentangle factors and characteristics that underlie choices and decision-making processes.

This thesis has therefore made contributions by analysing the social and cultural principles that determine what resilience strategies are important to dryland dwellers and therefore are likely to be supported and complied with and implemented fully to attain sustainability. Social principles such as identity and trust explored in chapters five and six respectively make unique contributions in the area of providing understanding of how communities assess and align with adaptation strategies to respond to climate change over time, and to build social-ecological resilience. These social mechanisms which have not received considerable attention however, could play crucial roles in many ways as the global resilience research community continues

to look for measures to address climate variability challenges in stressed environments in the face of increasing climate change impacts (Chapin et al., 2009).

As examined in Chapter 5, the influence of the principle of cultural identity of the communities could determine the level of support and compliance the people are willing to offer to viable climate change strategies. The success of expansion of NTFPs through commercialization, though suggested to hold a lot of promise in helping to address poverty in forest and savanna dependent communities for example (Ahenkan and Boon, 2010; Chapin, 2009), is largely dependent on understanding the value the people may place on specific aspects of their identity that may be changed or even be eroded in the face of new strategies they may perceive as 'foreign' and detrimental. High dependence on natural resources in the form of NTFPs clearly underscores the need to critically consider relevant sociocultural principles when designing measures to tackle climate change. Such strategies must be crafted incorporating local views and aspirations in order that the community will be assured of preserving their identity as ways are found to apply adaptation strategies to improve their capacity to adapt and respond to climate change.

8.3 Summary of the major findings

The main finding of the thesis has been the identification of the principles of: (1) trust, (2) cultural heritage, and (3) tradition and customs. As evident from the foregoing discussions, these principles could underlie resilience building strategies. Besides, discussions on the three principles answer the main research question: *What are the key underlying principles for the building of resilience in dryland ecosystems?* This study suggests that despite the relevance, potential or good intentions of any intervention designed to increase the capacity of communities to respond to changes, the building of trust through interactions borne over a longer time and cemented by experiences between the actors is an essential precursor to attaining success in any resilience activity or programme. People look beyond how good any relevant resilience strategy or project is, but place value on relationships, care and goodwill associated with projects. Thus, it is necessary to get social relations right, consider cultural context within which resilience interventions are directed, and also to rethink power and authority in society's structure and address their policy implications. As Samaddar et al (2018) point out, it is not enough for the relevance of the source of disaster preparedness information, but the trust of, and the show of care and concern, that are critical for acceptability. However, most interventions and strategies designed to help communities and individuals improve their

condition and build on capacity usually adopt a top-down approach and much focused on methods and techniques to succeed without appropriate attention to sociocultural foundations, values and principles that govern people's decisions, choices and practices. As noted in previous chapters, the idea of intent-driven trust plays an essential role to determine the acceptance, commitment and implementation of interventions, which is crucial for the success or failure of resilience interventions.

Consequently, these social principles must not be overlooked but should be identified, understood in the perspective of the communities as a matter of necessity in order to achieve full success of resilience project outcomes. This could allow for project design and implementation to occur in a bottom-up collaborative manner, resolving any local and context-specific concerns throughout the life of resilience interventions as and when they arise. Most important for building resilience is a bottom-up collaborative process that could ensure learning through experimentation, whilst reinforcing self-organising properties of the system to respond to future change. Particularly, trust potentially drives change in behaviour, actions and focus, and can determine how far, and for what reasons, people will be willing to go with projects for its lifetime. Trust has cultural underpinnings and traditional values contribute to social relations equipping the people to deal with environmental shocks. Religious context helps to understand the influence of traditional values on institutions and the emphasis on trust-based relationships. The study has helped to elucidate the contributions of these principles discussed above toward the building of social capacity and ways to galvanise the benefits of social capital for the greater good of society. With social capital, relationships between, and among groups and actors are crucial to foster cooperation and to create the needed collective action. However, this thesis has demonstrated through its findings that effective and productive relationship of actors may not be achieved without the cementing force of upholding cultural heritage, trust and incorporation of traditional knowledge and values. Findings of the study also highlighted the manifestations of some of the resilience building principles outlined by Biggs et al.'s (2015) research. For instance, connectivity between local community and external actors especially could facilitate learning, exchange of TEK provisions and flow of expertise. This principle also creates the platform for broadening consultation in order to harness any emerging new information promptly.

Enhancing resilience in drylands involves social-ecological theory, underlying ecological and social principles, the framing of these social principles within social capital, distilling the principles of trust, cultural identity and traditional values, and analysing their significance and

implications for climate change adaptation, is imperative. In this project we have assessed and discussed the relevant social principles people in drylands apply in building social-ecological resilience. The thesis has shown from the empirical analyses that social capital in the form of trust, cultural identity and respect for sociocultural and traditional practices play a critical role regarding choices, compliance and sustainability. It is therefore suggested that the strengthening and the move towards behavioural elements of change, empowering adaptive actions and capacity, where individual and community contextual principles are harnessed to achieve consensus, support and long-term compliance to adaptation strategies to climate change. It is evidently significant from the analysis that trust between communities and external agents is a dynamic bridge in fashioning strategies to respond to change.

8.4 The research questions and Wong's (2007) 'agency-institution-structure' framework

Wong refers to Agency as people's subjectivities, meanings of, and motivations for social cooperation. These attributes of agency then signal relationships that could evolve between people within communities. It stands to reason from the foregoing discussions that the notion of trust (see chapter 6) as a resilience could foster the effectiveness of these relationships, leveraging them for community support and acceptance. Whereas structure is the enabling and or the constraining factors that govern people's level of participation in their communities, institutions include formal organisations and or social norms and values that mediate and embed practices and shape interactions. Cultural identity as a mediating factor on how people might cooperate and participate in society aligns with the 'structure' aspect of Wong's framework. Trust on the other hand expresses people's motivations and subjective meanings ascribed to things and for that matter determines their willingness to participate in an activity, or opt out of it, thus, linking to their 'agency'. Finally, the traditional values and the norms of society as underlining factors that govern people's actions, explored in chapter 7 links with 'institutions' in Wong's framework that examines the concept of social capital (see section 6.2.3 in chapter 6). It is instructive therefore to understand how these elements in the framework and as revealed by our findings interweave with each other to produce the needed cooperation, acceptance and participation society needs to build resilience to respond to change. Such that insights from analysing Wong's framework reinforce and address the second and third research questions of this thesis, which attempted to unpick the principles that underlie people's responses to environmental changes, and the evidences thereof, which support the building of social-ecological resilience (see chapter one). Findings of this thesis therefore have contributed

to the understanding of how the principles of intent-driven trust, cultural identity and heritage and traditions ecological knowledge and practices operate within the elements of human agency, structures and institutions to generate a holistic framework of analysing social capital in ways that enable its greater benefits to be uncovered and utilised in the processes of building community social-ecological resilience.

As shown in Figure. 8.1, the three main findings of this thesis (the principles of trust, cultural heritage and tradition) interact with 'unseen' social capital described by Wong's (2007) framework of agency-structure-institutions. Within this framework, the agency component details the meanings attached to people's involvement in their social interactions, which aligns with the building of trust between actors towards the building of social-ecological resilience of SES as suggested by this thesis. The institution aspect of rules that mediate individual choices, reflects the principle of tradition and culture which possesses the potential of influencing peoples' daily decisions as revealed in this study. Finally, the structure aspect specifies the boundaries of people's interactions and manifest within his study in the form of the principle of attachment to cultural heritage that governs peoples' livelihood choices and alignments. Cultural heritage possesses the power to determine what people can forsake to embrace other uncommon, but viable alternative interventions for building resilience.

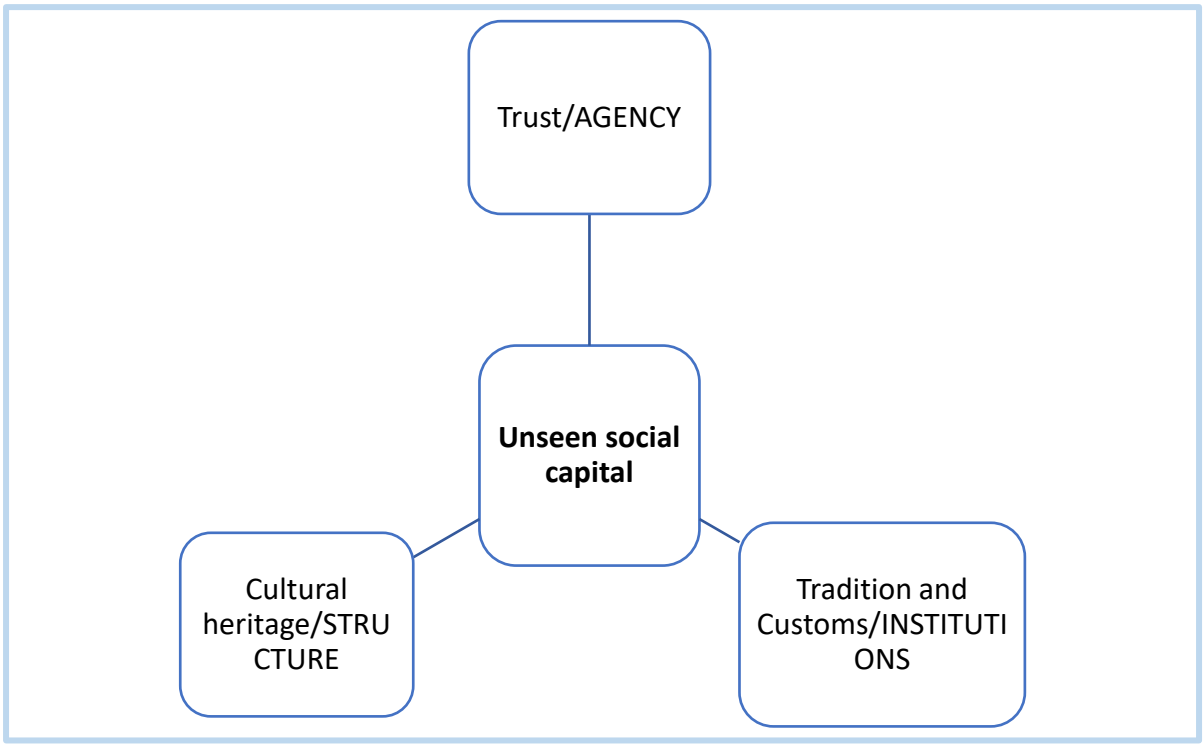


Fig. 8.1: Proposed social-ecological resilience principles triad of Cultural heritage, Trust and Traditional practices as attributes of unseen social capital.

8.5 Contribution of this thesis

The overall aim of this thesis was to understand how existing strategies and responses can be improved to optimise their contribution to communities' adaptive capacity in building resilience by understanding underlying principles that influence choices and decisions. Specifically, this thesis has contributed useful information by highlighting some specific principles relevant to dryland dwellers in the design and implementation of resilience strategies. Moreover, the following specific contributions have emerged from this thesis:

First, the findings of this thesis contribute to contemporary scholarly debates on the role of the adaptive capacity in building resilience in social-ecological systems. It highlights the need to turn attention to building social-ecological resilience by enhancing the adaptive capacity of households and communities. In this way, conceptual clarity may not be a challenge of developing strategies and implementing strategies to improve the social-ecological resilience of dryland SES.

Second, this study has made significant academic and policy contribution by highlighting what underlying principles matter and apply to dryland dwellers in building resilience strategies to drought and climate change in general. It has revealed the significance and need to focus research on subtle behavioural principles and emotions embedded within people but may manifest in choices and decisions, which often are neglected in the scholarly literature and debates to improve the application of research in building resilience in dryland ecosystems. This work has highlighted the need to understand and apply the extent by which the attachment of local communities to their cultural heritage associated with NTFP resources use makes it imperative to address it in order to obtain buy-ins and public acceptability for resilience strategies. Another principle the study helped to understand is the role of intent-driven trust between actors as a necessary precursor to success with resilience strategies in dryland communities. This intent-driven trust between actors is needed in order for resilience strategies in dryland communities such as planting of drought resistant trees and crops to be successful throughout their lifecycle. It demonstrates the fact that land as a common property is held in trust for the ancestors, thus, any signs of land grab will be resisted and may force viable resilience strategies to stop without completing their lifecycle and producing the intended

benefits to communities. Additionally, the findings from this thesis have revealed that traditions and religious practices are intricately connected to normal daily living and must be unpicked.

Third, most studies trying to address the measurement of resilience and the relevant principles have tended to centre on aggregate scale, thereby making it difficult to translate the concept into practice. However, this thesis makes the case for a more focused investigation of principles of building resilience relevant to dryland dwellers, which have to be characterised and considered when designing climate change adaptation strategies.

8.6 General limitations of this thesis

The data was analysed three years after fieldwork data collection and there is the possibility of certain aspects of living and conditions might have changed. Another related issue is the challenge of recall by respondents on critical historical facts and episodes. However, the fundamental principles and condition upon which the society operates is likely to remain unchanged therefore requiring the same attention as it needed three years ago. Cultural principles and values for example are largely engrained in people's thoughts and beliefs which do not shift easily but only build on new ideas to respond to change. Thus, the findings of the thesis are still relevant and applicable in building resilience to respond to change.

8.7 Conclusion and suggestions for further research

This research has focused on exploring and understanding separately the implications of trust, cultural identity and traditional values in building resilience. People in the study area are dependent for their livelihoods on NTFPs. This, in addition to farming, makes them more resilient to shocks in crop yields. The institutions that make the region food secure (through conventional farming and collection of NTFPs) are based on trust. Trust has cultural underpinnings and traditional values contribute to social relations equipping the people to deal with environmental shocks. Religious context helps to understand the influence of traditional values on institutions and the emphasis on trust-based relationships. Collectively, diverse livelihood options, trust-based institutions (chapter 6), cultural underpinnings of people's ability to deal with environmental shocks (chapter 7), and wider religious context (chapter 7) contribute to building social-ecological resilience.

This thesis has highlighted the building of social-ecological resilience via improving the adaptive capacity of households and communities can enhance conceptual clarity. It has also

stressed the significance of understanding behavioural, social relations and trust aspects of resilience embedded within communities that can improve acceptability and long-term success of resilience strategies. The thesis therefore suggests further studies that link the three principles, investigating their combined role in enhancing the capacity of communities in building social-ecological resilience in similar contexts and geographies. Typical further investigation could focus on exploring the extent to which cultural attachment, traditions and religious practices define trust aspects of resilience.

Additionally, broader lessons of framing resilience programmes by prioritising the adaptive capacity of systems can be learnt and replicated through further research and implementation across similar regions given the comparative nature of the principles of intent-driven trust, culture identity and TEK embedded within tradition and customs. Finally, the findings of this thesis could help to refocus policy directions in semi-arid regions by drawing insights to the underlying principles that govern actions and decisions. The thesis highlights a reimagining of policy framings for resilience projects, advocating for more social-technical considerations.

REFERENCES

Abarike, A. M., Yeboah, R. W. N., Dzomeku, I. K. (2018) Strategies of Farmers in the Bawku West District of Ghana to Mitigate the Impacts of Climate Variability on Farming. In: Saito, O. et al. (2018) (eds) Strategies for Building Resilience against Climate and Ecosystem Changes in Sub-Sahara Africa. Science for Sustainable Societies. Springer Nature Singapore Pte Ltd, 152 Beach Road, #21-01/04 Gateway East, Singapore 189721. Pp. 217-235.

Abdul-Razak, M. and Kruse, S. (2017) The Adaptive Capacity of Smallholder Farmers to Climate Chane in Northern Region of Ghana. *Climate Risk Management*.

Abson, D.J. (2014) Ecosystem services as a boundary object for sustainability. *Ecological Economics*, 102, 29-37.

Adam, Y.O. (2017) How many people globally "depend" on NTFPs (or "use" them or "trade" them)? *Agriculture and Forestry Journal*, Vol. 1, Issue 2, 73-78.

Adger W.N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D. R., Naess, L. O., Wolf, J. and Wreford, A. (2009) Are there social limits to adaptation to climate change. *Climate Change*, 93, 335-354.

Adger W.N., Arnell, N.W. and Tompkins, E.L. (2005) Successful adaptation to climate change across scales. *Global Environmental Change*, 15, 77-86.

Adger, W.N. and Vincent, K. (2005) Uncertainty in adaptive capacity. *Comptes Rendus Geoscience*, 337, 399-410.

Adger, W.N. (2003) Social, collective action and adaptation to climate change. *Economic Geography*, 79 (4), 387-404.

Adger, W.N. (2000) Institutional adaptation to environmental risk under the transition in Vietnam. *Annals of the Association of American Geographers*, 90 (4), 738-758.

Ahenkan, A. and Boon, E. (2011) Improving nutrition and health through non-timber forest products in Ghana. *Journal of Health, Population & Nutrition*, 29(2):141-148.

Ahenkan, A. and Boon, E. (2010) Commercialisation of non-timber forest products in Ghana: Processing, packaging and marketing. *Journal of Food, Agriculture and Environment,* Vol.8 (2): 962-969.

Aldunce, P., Borquez, R., Adler, C.E., Blanco, G. and Garreaud, R.D. (2016) Unpacking Resilience or Adaptation: Incorporating Practitioners' Experiences through a Transdisciplinary Approach to the Case of Drought in Chile. *Sustainability*, 8, 905, pp. 1-21.

Ambrose-Oji, B. (2003) The contribution of NTFPs to the livelihoods of the "forest poor". Evidence from the tropical forest zone of south-west Cameroon. *Int. For. Rev.* 5 (2): 2003.

Andriani, L. (2013) Social capital: A Road Map of Theoretical Framework and Empirical Limitations. Working Paper, Birkbeck College, University of London.

Angelstam, P., Andersson, K., Annerstedt, K., Axelsson, R., Elbakidze, M., Garrido, P., Grahn, P., K., Jönsson, K.I., Pedersen, S., Schlyter, P., Skärbäck, E., Smith, M. and Stjernquist, I. (2013) Solving Problems in Social-Ecological Systems: Definition, Practice and Barriers of Transdisciplinary Research. *AMBIO*, 42, 254-265.

Antwi-Agyei, P., Stringer, L. C. and Dougill, A. J. (2014). Livelihood adaptations to climate variability: insights from farming households in Ghana. *Regional environmental change*, *14*(4), 1615-1626.

Arizpe, L., Paz, F. and Velazquez, M. (1998) Culture and Global Change: Social perceptions of deforestation in the Lacandona rain forest in Mexico. The University of Michigan Press.

Balnaves, M. and Caputi, P. (2001). Introduction to quantitative research methods: An investigative approach. Sage Publications.

Béné, C., Al-Hassan, R.M., Amarasinghe, O., Fong, P., Ocran, J., Onumah, E., Ratuniata, R., Van Tuyen, T., McGregor, J.A. and Mills, D.J. (2016). Is resilience socially constructed? Empirical evidence from Fiji, Ghana, Sri Lanka, and vietnam. *Global Environmental Change*, *38*, pp.153-170.

Berkes, F. and Folke, C., (eds) (1998) Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience. Cambidge University Press, New York.

Berkes, F., Kofinas, G. P. and Chapin, F. S. (2009) Conservation, Community, and Livelihoods: Sustaining, Renewing, and Adapting Cultural Connections to the Land. In: Chapin, F. S., Kofinas, G. P., and Folke, C. (2009) (eds) Principle of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World, pp. 129-147. Springer Science, LLC, 233 Spring Street, New York, NY 10013, USA.

Bellwood, D.R., Hughes, T.P., Folke, C. and Nystrom, M. (2004) Confronting the coral reef crisis. *Nature*, 492: 827-833.

Bennett, E.M., Cumming, G.S. and Peterson, G.D. (2005) A Systems Model Approach to Determining Resilience Surrogates for Case Studies. *Ecosystems,* 8: 945-957.

Berg, B.L. (2009) Qualitative Research Methods for the Social Sciences. 7th ed. Boston: Allyn and Bacon.

Berman, R., Quinn, C.H. and Paavola, J. (2012) The role of institutions in the transformation of coping capacity to sustainable adaptive capacity. *Environmental Development*, 2, 86-100.

Bhagwat, S.A., Nogue, S. and Willis, K.J. (2014) Cultural drivers of reforestation in tropical forest groves of the Western Ghats of India. *Forest Ecology and Management*, 329, pp. 393-400.

Bhagwat, S. A., Nogue, S., and Willis, K. J. (2012) Resilience of an ancient tropical forest landscape to 7500 years of environmental change. *Biological Conservation,* 153, 108-117.

Biggs, R., Schluter, M. and Schoon, M.L. (eds)(2015) Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems. Cambridge University Press, UK.

Blommaert, J. and Jie, D. (2010) Ethnographic Fieldwork: A Beginner's Guide. Multilingual Matters, St. Nicholas House, 31-34 High Street, Bristol, BS1 2AW, UK.

Boafo, Y.A., Saito, O., Jasaw, G.S., Otsuki, K. and Takeuchi, K. (2016a) Provisioning ecosystem services-sharing as a coping and adaptation strategy among rural communities in Ghana's semi-arid ecosystem. *Ecosystems Services,* Vol.19, pp.92-102. https://doi.org/10.1016/j.ecoser.2016.05.002.

Boafo, Y.A., Saito, O., Kato, S., Kamiyama, C., Takeuchi, K. and Nakahara, M. (2016b) The role of traditional ecological knowledge in ecosystem services management: the case of four rural communities in Northern Ghana, *International Journal of Biodiversity Science, Ecosystem Services and Management, 12:1-2, 24-38*, DOI: 10.1080/21513732.2015.1124454

Boafo, Y.A., Osamu, S. and Takeuchi, K. (2014) Provisioning ecosystem services in rural savanna landscapes of Northern Ghana: an assessment of supply, utilization and drivers of change. *JDR.* 9:501-515.

Boakye-Danquah J., Antwi E.K., Osamu S., Abekoe M.K., Takeuchi K. (2014) Impact of farm management practices and agricultural land use on soil organic carbon storage potential in the savannah ecological zone of Northern Ghana. *JDR*. 9:484-500.

Bohensky, E.L., Evans, L.S., Anderies, J.M., Biggs, D. and Fabricius, C. (2015) Fostering complex adaptive systems thinking, pp. 142-165. In: Biggs, R., Schluter, M. and Schoon, M.L. (eds) Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems. Cambridge University Press, UK.

Booth, W.C, Colomb, G.G., Williams, J.M., Bizup, J. and FitzGerald, W.T. (2016) The Craft of Research. 4th ed. The University of Chicago Press. Chicago and London.

Brand, F.S and Jax, K. (2007) Focusing the Meaning(s) of Resilience: Resilience as a Descriptive Concept and a Boundary Object. *Ecology and Society*, 12(1):23.

Brooks, N., Adger, W.N., and Kelly, P.M. (2005) The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. *Global Environmental Change*, **15**, 151-163.

Brown, K., Adger, W.N., Devine-Wright, P., Anderies, J., Barr, S., Bousquet, F., Butler, C., Evans, L., Marshall, N. and Quinn, T. (2019) Empathy, Place and Identity interactions for sustainability. *Global Environmental Change*, 56, 11-17.

Brown, K. (2014) Global Environmental Change 1: A social turn for resilience? *Progress in Human Geography*, Vol. 38(1), 107-117.

Bruijn, M. de and Dijk, H. van (2004) The importance of socio-cultural differences and of pathway analysis for understanding local actors' responses, pp.341-362. In: Dietz, A.J. Ruben, R. and Verhagen, A. (2004) The Impact of Climate Change on Drylands: With a Focus on West Africa. Kluver Academic Publishers, P.O. Box 322, 3300 AH Dordrecht, The Netherlands.

Cardinal, B. J., et al. (2012) Biodiversity loss and its impact on humanity. *Nature*, 486 (7401):59-67.

Carpenter, S. R. and Brock, W. A. (2008) Adaptive Capacity and Traps. *Ecology and Society*, 13(2): 40.

Carpenter, S.R., Westley, F. and Turner, M.G. (2005) Surrogates for resilience of social-ecological systems. *Ecosystem*, 8:1-5.

Carpenter S.R., Walker B.H., Anderies J.M. and Abel N. (2001) From Metaphor to Measurement: Resilience of What to What? *Ecosystems*, 4: 765-781.

Casey, T. (2004) Social Capital and Economic Performance in American States. *Social Science Quarterly*, 86, 4, 826-845.

Chapin, F. S., Kofinas, G. P. and Folke, C. (2009) (eds) Principle of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World. Springer Science, LLC, 233 Spring Street, New York, NY 10013, USA.

Chapin, F. S. III (2009) Managing Ecosystems Sustainability: The Key of Resilience. In: Chapin, F. S. III et al. (2009) (eds) Principle of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World. Springer Science, LLC, 233 Spring Street, New York, NY 10013, USA. Pp. 29-53.

Chapin, F. S. III, Folke, C. and Kofinas, G. P. (2009) A framework for understanding change. In: Chapin, F. S. III., Kofinas, G.P. and Folke, C. (2009) (eds) Principle of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World. Springer Science, LLC, 233 Spring Street, New York, NY 10013, USA. Pp. 3-28.

Chaudhury, A.S., Thornton, T.F., Helfgott, A., Ventresca, M.J. and Sova, C. (2017). Ties that bind: Local networks, communities and adaptive capacity in rural Ghana. *Journal of Rural Studies*, *53*, pp.214-228.

Cherlet, M. et al. (2018) World atlas of desertification. Publication Office of the European Union, Luxembourg.

Chiotha, S., Jamu, D., Nagoli, J., Likongwe, P., and Chanyenga. T. (eds) (2018) Socio-Ecological Resilience to Climate Change in a Fragile Ecosystem: The case of the Lake Chilwa Basin, Malawi. Routledge, 2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN.

Chiotha, S., Daniels, E., Gillick, S., Jamu D., Likongwe, P. and Vokhiwa, Z. (2018) Ecosystem approach: Theory into practice. In: Chiotha, S., Jamu, D., Nagoli, J., Likongwe, P., and Chanyenga. T. (eds) (2018) Socio-Ecological Resilience to Climate Change in a Fragile Ecosystem: The case of the Lake Chilwa Basin, Malawi. Routledge, 2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN. Pp. 11-48.

Chrupala-Pniak, M., Grabowski, D. and Sulimowska-Formowicz, M. (2016) The value of trust in inter-organizational relations. *Economics and Business Review*, Vol. 2 (16), No. 2.

Chunhabunyatip, P., Sasaki, N., Grünbühel, C., Kuwornu, J.K.M. and Tsusaka, T.W. (2018) Influence of Indigenous Spiritual Beliefs on Natural Resource Management and Ecological Conservation in Thailand. *Sustainability*, 10, 2842; doi:10.3390/su10082842.

Clare, A., Graber, R., Jones, L. and Conway, D. (2017) Subjective measures of climate resilience: what is the added value for policy and programming? *Global Environmental Change, 46,* pp.17-22.

Clark, V. L. P. and Creswell, J. W. (2011). Designing and conducting mixed methods research. SAGE Publications, 2nd Edition.

Cooper, M., Zvoleff, A., Gonzalez-Roglich, M., Tusiime, F., Musumba, M., Noon, M., Alele, P. and Nyiratuza, M. (2018) Geographic factors predict wild food and non-food NTFP collection by households across four African countries. *Forest Policy and Economics*, 96, pp. 38-53.

Corbetta, P. (2003) Social Research: theory, method and techniques. London: Sage

Corning, P.A. (1995) Synergy and self-organization in the evolution of complex systems. *Systems Research,* 12 (2): 89-121.

Cote, I.M. and Darling, E.S. (2010) Rethinking Ecosystem Resilience in the Face of Climate Change. PLoS Biol, 8(7): e1000438. doi:10.1371/journal.pbio.1000438.

Creswell, J. W. (2013). Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications.

Cumming, G.S., Barnes, G., Perz, S., Schmink, M., Sieving, K.E., Southworth, J., Binford, M., Holt, R.D., Stickler, C. and Van Holt, T. (2005) An Exploratory Framework for the Empirical Measurement of Resilience. *Ecosystems*, 8, 975-987.

Cundill, G., Leitch, A.M., Schultz, L., Armitage, D. and Peterson, G. (2015) Encourage learning. In: Biggs, R., Schluter, M. and Schoon, M.L. (eds) Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems. Cambridge University Press, UK.

Creswell, J. W. (2014). A concise introduction to mixed methods research. SAGE Publications.

d'Errico, M., Grazioli, F. and Pietrelli, R. (2018). Cross-country Evidence of the Relationship Between Resilience and the Subjective Perception of Well-being and Social Inclusion:

Evidence from the Regions of Matam (Senegal) and the Triangle of Hope (Mauritania). *Journal of International Development*, *30*(8), pp.1339-1368

De Groot, J. I. M. and Schnitema, G. (2012) How to make the unpopular popular? Policy characteristics, social norms and the acceptability of environmental policies. *Environmental Science and Policy*, 19-20, 100-107.

Delgado, T. S., McCall, M. K., and Lopez-Binquist, C. (2016) Recognized but not supported: Assessing the incorporation of non-timber forest products into Mexican forest policy. *Forest Policy and Economics*, 71, pp. 36-42.

Denscombe, M. (2010). The good research guide: For small-scale social research projects: For small-scale social research projects. McGraw-Hill International.

Diamond, J.M. (2005) Collapse: how societies choose to fail or succeed. Viking Penguin, Penguin Group, U.S.A. Inc., 375 Hudson Street, New York, New York 10041 U.S.A.

Dietz, A.J., Ruben, R. and Verhagen, A. (2004) The Impact of Climate Change on Drylands: With a Focus on West Africa. Kluver Academic Publishers, P.O. Box 322, 3300 AH Dordrecht, The Netherlands.

Dokken, D.J. and White, K.S. (eds). Climate change (2001): impacts, adaptation and vulnerability. Cambridge: Cambridge University Press, pp. 877-912.

Eisenhardt, K. M., and Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. Academy of management journal, 50(1), 25-32.

Elbehri, A., Genest, A. and Burfisher, M. (2011) Global Action on Climate Change in Agriculture: Linkages to Food Security, Markets and Trade Policies in Developing Countries. FAO, Rome.

Elser, J.R., Miles, S. and Frewer, L.J. (2002) Trust, perceived risk and attitudes toward food technologies. *Journal of Applied Social Psychology*, 32 (11): 2423-2433.

Engle, N.L. (2011) Adaptive capacity and its assessment. *Global Environmental Change*, 21, 647-656.

FAO (2011) The Role of Women in Agriculture. ESA Working Paper No. 11-02. Available online at http://www.fao.org/3/am307e/am307e00.pdf (Accessed on 25/03/2020).

FAO (2001) Trees outside forests- towards rural and urban integrated resources management contribution to the forest resources assessment 2000 Report. Rome, FAO, Italy.

FAO (1999) FAO forestry – towards a harmonised definition of non-wood forest products. Unasylva, 50:198.

Feng, S. and Fu, Q. (2013) Expansion of global drylands under warming climate. Atmos Chem Phys, 13(9): 10081-10094.

Fine, B. (2002) It Ain't Social, It Ain't Capital and It Ain't Africa. *Studia Africana*, No. 13, 2002, pp. 18-33.

Flick, U. (2002) An Introduction to Qualitative Research (2nd Ed). London: Sage.

Fontana, A. and Frey, J. H. (1994) Interviewing: The Art of Science. In: Denzen, N. a. Y. L. (ed) The handbook of Qualitative Research. Thousand Oak: Sage Publications, pp. 361-376.

Folke, C. (2016) Resilience (Republished). *Ecology and Society* 21(4):44.

Folke, C., Carpenter, S.R., Walker, B., Scheffer, M., Chapin, T. and Rockström. J. (2010) Resilience thinking: integrating resilience, adaptability and transformability. Ecology and Society 15(4): 20. [online] URL: http://www.ecologyandsociety.org/vol15/iss4/art20/

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C.S. and Walker, B. (2002) "Resilience and sustainable development: Building adaptive capacity in a world of transformations". *Ambio*, 31 (5): 437-440.

Frake, C. O. (1962) Cultural Ecology and Ethnography. American Anthropology.

Fukuyama, F. (2001) Social Capital, Civic Society and Development. *Third World Quarterly*, 22,1, 7-20.

Gallopin, G.C. (2006) Linkages between vulnerability, resilience, and adaptive capacity. *Global Environmental Change*, 16, 293-303.

Ghana Forestry Commission (2012) Ghana investment plan for the Forest Investment Programme (FIP).

Ghana Statistical Service (2014) Ghana living standards survey round 6.

Glaser, B. G. (1978). Theoretical sensitivity: Advances in the methodology of grounded theory. Sociology Pr.

Glaser, B.G and Strauss, A.L. (1967) The discovery of grounded theory: Strategies for qualitative research. Hawthorne, NY: Aldine de Gruyter.

González-Cruz, G., García-Frapolli, E., Casas, A. and Dupuy, J.M. (2015) Responding to disturbances: lessons from a Mayan social-ecological system. *International Journal of the Commons*, Vol. 2, pp. 831-850.

Gordon, L. J. and Enfors, E. I. (2008) Land Degradation, Ecosystem Services and Resilience of Smallholder Farmers in Makanya Catchment, Tanzania. In: Bossio, D. and Geheb, K. (eds) Conserving Land, Protecting Water. Comprehensive Assessment of Water Management in Agricultural Series, Vol. 6, CAB International, Wallingford, UK and Cambridge MA, USA. Pp.33-50.

Grafton, R.Q. (2005) Social capital and fisheries governance. *Ocean and Coastal Management*, 48, 753-766.

Greene, J. C., Caracelli, V. J. and Graham, W. F. (1989). Toward a Conceptual Framework for Mixed-Method Evaluation Designs. *Educational Evaluation and Policy Analysis*, 11(3), 255-274.

Greene, J. C. (2006). Toward a Methodology of Mixed Methods Social Inquiry. *Research in the Schools*, 13(1), 93-98.

Greene, J. C., Benjamin, L. and Goodyear, L. (2001). The Merits of Mixing *Methods in Evaluation. Evaluation*, 7(1), 25-44.

Grivins, M. and Tisenkopfs, T. (2018) Benefitting from the global, protecting the local: The nested markets of wild product trade. *Journal of Rural Studies*, Vol. 61, pp.335-342.

Gumo, S., Gisege, S., Raballah, E. and Ouma, C. (2012) Communicating African spirituality through ecology: challenges and perspectives for the 21st Century. *Religions*, **3**, 523-543.

Gunderson, L. H. and Holling, C. S. (eds) (2002) Panarchy: understanding transformations in human and natural systems. Island Press, Washington, DC.

Gunderson, L. H. (2000) Ecological resilience – in theory and application. *Annual Review of Ecology and Systematics*, 31, 425-439.

Gyasi, E. A. and Awere, K.G. (2018) Adaptation to Climate Change: Lessons from Farmers Responses to Environmental Changes in Ghana. In: Saito, O. et al. (2018) (eds) Strategies for

Building Resilience against Climate and Ecosystem Changes in Sub-Sahara Africa. Science for Sustainable Societies. Springer Nature Singapore Pte Ltd, 152 Beach Road, #21-01/04 Gateway East, Singapore 189721. Pp. 291-312.

Habermas, J. (1984) The Theory of Communicative Action. Boston: Beacon Press, Vol. 1.

Hadish, G. (2018) Review on the Roles of NTFPs for Rural Livelihood. *Journal of Biology, Agriculture and Healthcare,* Vol.8 (1), 10-14.

Haider, L.J., Boonstra, W.J., Akobirshoeva, A. and Schlüter, M. (2019) Effects of development interventions on biocultural diversity: a case study from the Pamir Mountains. *Agriculture and Human Values*. Springer.

Haile, A. W. and Tatek, D. (2013) Dryland Ecosystems: Their Features, Constraints, Potentials and Managements. *Research Journal of Agricultural and Environmental Management*, Vol. 2(10), pp. 277-288.

Hammersley, M. and Atkinson, P. (2007). Ethnography: Principles in practice. Routledge.

Hanson, W. and Heeks, R. (2020) Impact of ICTs-in-Agriculture on Rural Resilience in Developing Countries. Development Informatics, CDI, Working Paper Series, Paper No. 84.

Haluza-DeLay, R. (2014) Religion and climate change: varieties in viewpoints and practices. *WIREs Clim Change*. Doi: 10.1002/wcc.268.

Holling, C. S. (1996) Engineering resilience verses ecological resilience. In: Schulze, P. (ed). Engineering within Ecological Constraints. National Academy, Washington, DC, USA, pp. 31-44.

Holling, C. S. (1973) Resilience and Stability of Ecological Systems. Annual Review of Ecology and Systematics, Vol. 4:1-23.

Holling C.S. and Meffe, G.K., (1996) Command and Control and the Pathology of Natural Resource Management. Conservation Biology, 10, 2, 328 – 337.

Holliday, A. (2002), Doing and Writing Qualitative Research. London: Sage Publications.

IPCC (2014) Climate change 2014: impacts, adaptation, and vulnerability. Part A: global and sectoral aspects, contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change. In: Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C.,

Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., White, L.I. (eds). Summary for Policymakers, Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA, 1-32.

IPCC (2007) Climate change 2007: impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press. p. 869.

Issaka, Y. B. (2018) Non-timber Forest Products, Climate Change Resilience, and Poverty Alleviation in Northern Ghana. In: Saito, O. et al. (2018) (eds) Strategies for Building Resilience against Climate and Ecosystem Changes in Sub-Sahara Africa. Science for Sustainable Societies. Springer Nature Singapore Pte Ltd, 152 Beach Road, #21-01/04 Gateway East, Singapore 189721. Pp. 179-192.

Jansujwicz, J. S., Calhoun, A. J., Leahy, J. E. and Lilieholm, R. J. (2013). Using mixed methods to develop a frame-based private landowner typology. *Society & Natural Resources*, 26(8), 945-961.

Jasaw, G.S., Saito, O., Gasparatos, A., Shoyama, K., Boafo, Y.A. and Takeuchi, K. (2017) Ecosystem services trade-offs from high fuelwood use for traditional shea butter processing in semi-arid Ghana. *Ecosystem Services*, 27, 127-138.

Jensen, E.A. and Laurie C. (2016) Doing real research: A practical guide to social research. Sage Publications Ltd, 1 Oliver's Yard, 55 City Road, London, EC1Y 1SP.

Johnson, R. B. and Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational researcher*, 33(7), 14-26.

Jancowicz, A.D. (2000) Business Research Projects. 3rd ed. Holborn: Thomson Learning.

Jones, N. and Clark, J. R. A. (2013) Social capital and climate change mitigation in coastal areas: A review of current debates and identification of future research directions. *Ocean and Coastal Management,* 80, 12-19.

Jones, L., Ludi, E. and Levine, S. (2010) Towards a characterization of adaptive capacity: a framework for analyzing adaptive capacity at the local level. ODI Background Note.

Keys, N., Thomsen, D.C. and Smith, T.F. (2014) Adaptive capacity and climate change: the role of community opinion leaders. Local Environment: *The International Journal of Justice and Sustainability,* DOI: 10.1080/13549839.2014.967758.

Blomqvist, K. (1997) The Many Faces of Trust. *Scand. J. Mgmt, Vol. 13. pp. 271-286.*

Kitchin, R. and Tate, N.J., (2000) Conducting Research in Human Geography: theory, methodology and practice. Harlow: Prentice Hall.

Lee, D.R. et al (2014) Developing local adaptation strategies for climate change in agriculture: A priority-setting approach with application to Latin America. *Global Environmental Change*, 29, 78-91.

Kramer, R. M. (1999) Trust and distrust in organizations: emerging perspectives, enduring questions. *Annual Review of Psychology, **50**, 569-598.*

Lebel, L., Anderies, J.M., Campbell, B., Folke, C., Hatfield-Dodds, S., Hughes, T.P. and Wilson, J. (2006) Governance and the capacity to manage resilience in social-ecological systems. *Ecology and Society, 11, 19*.

Leitch, A.M., Cundill, G., Schultz, L. and Meek, C.L. (2015) Broaden participation. In: Biggs, R., Schluter, M. and Schoon, M.L. (eds) Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems, pp. 201-225. Cambridge University Press, UK.

Likoswe, M., Chanyenga, T., Mphepo, G., Utila, H., Meke, G., Chithila, V. and Sagona. W. (2018) Building resilience of ecosystems and people's livelihood through afforestation. In: Chiotha, S., Jamu, D., Nagoli, J., Likongwe, P., and Chanyenga. T. (eds) (2018) Socio-Ecological Resilience to Climate Change in a Fragile Ecosystem: The case of the Lake Chilwa Basin, Malawi. Routledge, 2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN. Pp.60-75.

Lorenzoni, I., Nicholson-Cole, S. and Whitmarsh, L. (2007) Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change*, 17, 445-459.

Lucatello, S., Huber-Sannwald, E., Espejel, I. and Taguena, N.M. (eds)(2020) Stewardship of Future Drylands and Climate Change in the Global South: Challenges and Opportunities for the Agenda 2030. Springer Nature Switzerland AG 2020.

Lucatello, S and Huber-Sannwald, E. (2020) In: Lucatello, S., Huber-Sannwald, E., Espejel, I. and Taguena, N.M. (eds)(2020) Stewardship of Future Drylands and Climate Change in the

Global South: Challenges and Opportunities for the Agenda 2030. Springer Nature Switzerland AG 2020. Pp. 27-40.

Lutz, M. B. and Lutz, S. H. (2004) The Contribution of Income, Social Capital and Institutions to human well-being in Africa. ZEI Working Paper, B 07 2004.

Mahonya, S., Shackleton, C.M. and Schreckenberg, K. (2019) Non-timber Forest Product Use and Market Chains Along a Deforestation Gradient in Southwest Malawi. Frontiers For Global Change, 2:71.

Mathevet, R., Thompson. J.D., Folke, C. and Stuart Chapin III, F. (2016) Protected areas and their surrounding territory: social-ecological systems in the context of ecological solidarity. Ecological Applications, 26, 5-16.

Mearns, R. and Norton, A. (2010) Dimensions of Climate Change, Equity and Vulnerability in a Warming World. The World Bank, Washington DC.

Milligan, J., O'Riordan, T., Nicholson-Cole, S.A. and Watkinson, A.R. (2009) Nature conservation for future sustainable shorelines: lessons from seeking to involve the public. *Land Use Policy*, 26, 203-213.

Moffat, K., Lacey, J., Zhang, A. and Leipold, S. (2016) The social licence to operate: A critical review. Forestry: An *International Journal of Forest Research*. 89(5):477-488. https://doi.org/10.1093/forestry/cpv044.

Miles, M. and Huberman, A.M. (1994) Qualitative Data Analysis. Sage Publications, Thousand Oaks, CA.

Millennium Ecosystem Assessment (MEA, 2005) Ecosystem services and Human well-being: Scenarios. Island Press, Washington.

Milman, A. and Arsano, Y. (2014) Climate adaptation and development: Contradictions for human security in Gambella, Ethiopia. *Global Environmental Change*, 29, 349-359.

Morse, J.M. (2009). Mixing Qualitative Methods. *Qualitative Health Research*, 19, 1523–1524.

Myatt, L.B., Scrimshaw, M.D. and Lester, J.N. (2003) Public perceptions and attitudes towards a forthcoming managed realignment scheme: Freiston Shore, Lincolnshire, UK. *Ocean and Coastal Management*, 46, 565-582.

Newsham, A. and Bhagwat, S. (2016) Conservation and Development. Routledge, 2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN.

Newton, K. (1997) Social capital and democracy. *American Behavioural Scientist, 40(5), 575-586*

Nguyen, K. V., and James, H. (2013). Measuring household resilience to floods: A case study in the Vietnamese Mekong River Delta. *Ecology and Society*, *18* art. 13-art. 13

Nyborg, K., Anderies, J.M., Dannenberg, A. et al. (2016) Social norms as solution: Policies may influence large-scale behavioural tipping. *Science*, Vol.354, Issue, 6308, 42-43.

Nyantakyi-Frimpong, H. and Bezner-Kerr, R. (2015) The relative importance of climate change in the context of multiple stressors in semi-arid Ghana. *Global Environmental Change*, 32, 40-56.

O'Connor, J. and McDermott, I. (1997) The Art of Systems Thinking: Essential Skills for Creativity and Problem Solving.

Odum, E. P. (1953) Fundamentals of Ecology. W. B. Saunders and Co., Philadelphia and London.

O'Leary, Z. (2013). The essential guide to doing your research project. Sage Publications.

Olson, M. (1965) The Logic of Collective Action: Public Goods and the Theory of Groups. Oxford: Oxford University Press.

Olsson, L., Jerneck, A., Thoren, H., Persson, J. and O'Byrne, D. (2015) Why resilience is unappealing to social science: Theoretical and empirical investigations of the scientific use of resilience. *Sci. Adv*. 1 (4), e1400217.

Omer, K. (2017) Rethinking Transect Walk and Community Mapping Process: The methodologies and techniques. Working Paper, University of Manchester.

O'Neill, R.V., Deangelis, D.L., Waide, J.B. and Allen, T.F.H. (1986) A hierarchical Concept of Ecosystems. Princeton University Press, Princeton, New Jersey, USA.

Ostrom, E. (2011) Background on the institutional analysis framework. *Policy Stud. J*. 39, 7-27.

Ostrom, E. and Walker, J. (2003) Trust and reciprocity: Interdisciplinary Lessons for Experimental Research. Russell Sage Foundation.

Ostrom, E. and Ahn, T.K. (2003) Foundations of Social Capital. Edward Elgar Pub., Northampton, MA.

Ostrom, E. (2001) Vulnerability and polycentric governance systems. IHDP Update 3/01, 1-4.

Oteng-Ababio, M. (2013) Prevention is better than cure: assessing Ghana's preparedness (capacity) for disaster management: original research. Jamba, *Journal for Disaster Risk Studies, 5 (2): 1-11.*

Paton, D. (2008) Risk communication and natural hazard mitigation: how trust influences its effectiveness. *Int. J. Glob. Environ Issues*, 8(1-2): 2-16.

Paton, D. (2007) Preparing for natural hazards: the role of community trust. *Disaster Prev. Management*, 16 (3): 370-379.

Patton, M.Q. (1999). Enhancing the Quality and Credibility of Qualitative Analysis. *Health Sciences Research,* 34, 1189–1208.

Paul, C.J., Weinthal, E.S., Bellemare, M.F. and Jeuland, M.A. (2016) Social capital, trust and adaptation to climate change: Evidence from rural Ethiopia. *Global Environmental Change*, 36, 124-138.

Pereira, L. (2017) Climate Change Impacts on Agriculture across Africa. Oxford Research Encyclopedia, Environmental Science, Oxford University Press.

Peter Senge (2014): https://www.youtube.com/watch?v=0QtQqZ6Q5-o (Accessed 25/10/19).

Peters, R.G., Covello, V.T. and McCallum, D.B. (1997) The determinants of trust and credibility in environmental risk communication. Risk Anal, 17 (1): 43-54.

Place, F., and Otsuka, K. (2000). The role of tenure in the management of trees at the community level: Theoretical and empirical analyses from Uganda and Malawi. CGIARSystem-wide Program on Collective Action and Property Rights, International Food Policy Research Institute.

Polasky, S., Zeeuw, A. and Wagener, F. (2011) Optimal management with potential regime shifts. *Journal of Environmental Economics and Management*, 62: 229-240. https://doi.org/10.1016/j.jeem.2010.09.004.

Potter, S. (2006) Doing Postgraduate Research. London: Sage, 2nd Edition.

Pretty, J. (2008) Investments in Collective Capacity and Social Capita. In: Bossio, D. and Geheb, K. (eds) Conserving Land, Protecting Water. Comprehensive Assessment of Water Management in Agricultural Series, Vol. 6, CAB International, Wallingford, UK and Cambridge MA, USA. Pp. 178-190.

Punch, K. F. (2014). Introduction to social research: Quantitative and qualitative approaches. Sage Publications, 3rd Edition.

Put, M., Verhagen, J., Veldhuizen, J. and Jellema, P. (2004) Climate change in dryland West Africa? The empirical evidence of rainfall variability and trends. In: Dietz, A.J. Ruben, R. and Verhagen, A. (2004) The Impact of Climate Change on Drylands: With a Focus on West Africa. Kluver Academic Publishers, P.O. Box 322, 3300 AH Dordrecht, The Netherlands.

Putnam, R. (2000) Bowling Alone: The collapse and Revival of American Community. Simon and Schuster, New York, pp.22.

Putnam, R. D., Leonardi, R. and Nanetti, R. Y. (1993) Making Democracy Work, Princeton: Princeton University Presss.

Quinn, C. H., Ziervogel, G., Taylor, A., Takama, T. and Thomalla, F. (2011) Coping with Multiple Stresses in Rural South Africa. *Ecology and Society*, 16(3):2.

Republic of Ghana (2012) Legislative Instrument 2100, Establishment of Daffiama-Bussie-Issa District Assembly.

Roncoli, C., Crane, T., Orlove, B. (2009) Fielding climate change in cultural anthropology. Anthropology and Climate Change: From Encounters to Actions, pp. 87-115.

Reynolds, JF, Smith, DMS, Lambin, EF, Turner II, BL., Mortimore, M., Batterbury, SPJ., Downing, TE., Dowlatabadi, H., Fernández, RJ., Herrick, JE., Huber-Sannwald, E., Jiang, H., Leemans, R, Lynam, T., Maestre, FT., Ayarza, M. and Walker, B. (2007) Global Desertification: Building a Science for Dryland Development. *Science*, 316, 847.

Richmond, B. (1993) System thinking: critical thinking skills for 1990s and beyond. *System Dynamics Review*, 9,2, pp.113-33.

Rivers III, L. and Gibbs, C. (2011) Applying a conservation-criminology framework to common-pool natural-resource issues. *International Journal of Comparative and Applied Criminal Justice*, 35:4, 327-346.

Robinson, L.W. and Berkes, F. (2010) Applying Resilience Thinking to Questions of Policy for Pastoralist Systems: Lessons from the Gabra of Northern Kenya. *Human Ecology*, Vol. 38, No. 3, pp. 335-350.

Sabatini, F. (2006) "The Empiric Social Capital and Economic Development: A Critical Perspective". Fondazone ENI Enrico Mattei Nota di Lavoro 15.2006.

Sachs, J.D. (2015) The Age of Sustainable Development. Columbia University Press, New York, Chichester, West Sussex.

Saito, O., Kranjac-Berisavljevic, G., Takeuchi, K. and Gyasi E. A. (2018) (eds) Strategies for Building Resilience against Climate and Ecosystem Changes in Sub-Sahara Africa. Science for Sustainable Societies. Springer Nature Singapore, Pte Ltd, 152 Beach Road, #21-01/04 Gateway East, Singapore 189721.

Samaddar, S., Yokomatsu, M., Dzivenu, T., Oteng-Ababio, M., Adams, M., Dayour, F., Ishikawa, H. (2018) Exploring the Role of Trust in Risk Communication Among Climate-Induced Vulnerable Rural Communities in Wa West District, Ghana. In: Saito, O. et al. (2018) (eds) Strategies for Building Resilience against Climate and Ecosystem Changes in Sub-Sahara Africa. Science for Sustainable Societies. Springer Nature Singapore Pte Ltd, 152 Beach Road, #21-01/04 Gateway East, Singapore 189721. Pp. 247-264.

Samaddar, S., Yokomatsu, M., Dzivenu, T., Oteng-Ababio, M., Adams, M., Dayour, F., Ishikawa, H. (2014) Assessing Rural Communities Concerns for Improved Climate Change Adaptation Strategies in Northern Ghana. *Journal of Disaster Research, Vol.9 (4):529-541.*

Sauri, D., Domingo, V., and Romero, A. (2003) Trust and community building in the Donana (Spain) toxic spill disaster. *Journal of Risk Research, 6(2), 145-162.*

Schluter, M., Biggs, R., Schoon, M.L., Robards, M.D. and Anderies, J.M. (2015) Reflections on building resilience – interactions among principles and implications for governance. In: Biggs, R., Schluter, M. and Schoon, M.L. (eds)(2015) Principles for Building Resilience:

Sustaining Ecosystem Services in Social-Ecological Systems. Cambridge University Press, UK. pp. 251-282.

Schoon, M.L., Robards, M.D., Brown, K., Engle, N., Meek, C.L. and Biggs, R. (2015) Politics and the resilience of ecosystem services. In: Biggs, R., Schluter, M. and Schoon, M.L. (eds) Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems. Cambridge University Press, UK, pp. 32-49.

Shackleton, C.M., Ticktin, T. and Cunningham, A.B. (2018) Nontimber forest products as ecological and biocultural keystone species. *Ecology and Society*, 23(4): 22.

Shackleton, C. M. and Pandey, A. K. (2013) Positioning non-timber forest products on the development agenda. *Forest Policy and Economics*.

Shackleton, C.M., Shackleton, S., Buiten, E. and Bird, N. (2007) The importance of dryland woodlands and forests in rural livelihoods and poverty alleviation in South Africa. *Forest Policy Econ*. 9 (5): 558-577.

Shulman, L.S. (1986) Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher*, Vol. 15, No. 2, pp. 4-14.

Sietz, D., Ludeke, M.K.B. and Walther, C. (2011) Categorisation of typical vulnerability patterns in global drylands. *Global Ecological Change*, 21, 431-440.

Simelton, E., Fraser, EDG., Termansen, M., Forster, PM. and Dougill, AJ. (2009) Typologies of crop-drought vulnerability: an empirical analysis of the socio-economic factors that influence the sensitivity and resilience to drought of three major food crops in China (1961-2001). *Environmental Science & Policy*, 12(4): 438-452.

Smit, C. S. and Malik, S.A. (2012) Adaptation to Climate Change in Low-Income Countries: Lessons from Current Research and Needs from Future Research. Institute for International Economic Policy Working Paper Series, The George Washington University.

Smit, B. and Wandel, J. (2006) Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, 16, 282-292.

Smit, B. and Pilifosova, O. (2001) Adaptation to climate change in the context of sustainable development and equity. In: McCarthy, J.J., Canziani, O.F., Leary, N.A.,

Smith, D. M. S. (2009) Drylands: Coping with Uncertainty, Thresholds, and Changes in State. In: Chapin, F. S. III et al. (2009) (eds) Principle of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World. Springer Science, LLC, 233 Spring Street, New York, NY 10013, USA. Pp. 171-195.

Snorek, J., Renaud, F.G. and Kloos, J. (2014) Divergent adaptation to climate variability: A case study of pastoral and agricultural society in Niger. *Global Environmental Change*, 29, 371-386.

Statistical Package for Social Sciences (SPSS). IBM SPSS Statistics 20.

Stringer, L.C., Dougill, A.J., Fraser, E., Hubacek, K., Prell, C. and Reed, M.S.R. (2006). Unpacking "participation" in the adaptive management of social–ecological systems: a critical review. Ecology and Society 11(2): 39. [online] URL: http://www.ecologyandsociety.org/vol11/iss2/art39/

Talvitie, A. (2011) The problem of trust in planning. *Planning Theory, 11(3) 257-278.*

Tambo, J. A. (2016). Adaptation and resilience to climate change and variability in north-east Ghana. *International Journal of Disaster Risk Reduction*, *17*, 85-94.

Terpstra, T. (2011) Emotions, trust, and perceived risk: affective and cognitive routes to flood preparedness behaviour. *Risk Anal* 31(10): 1658-1675.

Thomson I. and Boutilier, R. (2011) Social licence to operate. In SME Mining Engineering Handbook, 3rd edn. Darling, P. (ed.). Society for Mining, Metallurgy and Exploration, pp. 1779-1796.

Thornton, T. F. and Manasfi, N. (2010) Adaptation – Genuine and Spurious: Demystifying Adaptation Processes in Relation to Climate Change. *Environment and Society*, Vol. 1 (1) 132-155.

Tompkins, E.L. and Adger, W.N. (2004) Does adaptive management of natural resources enhance resilience to climate change? *Ecology and Society*, 9 (2) 10.

Tompkins, E.L. and Eakin, H. (2012) Managing private and public adaptation to climate change. *Global Environmental Change*, 22, 3-11.

Tie, C. Y., Birks, M. and Francis, K. (2019) Grounded theory research: A design framework for novice researchers. SAGE Open Medicine, Vol. 7: 1-8.

Tietjen, B. and Jeltsch, F. (2007) Semi-arid gazing systems and climate change: a survey of present modelling potential and future needs. *Journal of Applied Ecology*, 44, 425-434.

UNCCD (2017a) Land degradation neutrality: transformative action, tapping opportunities.

UNCCD (2017b) The Global Land Outlook, 1st edition, Bonn, Germany.

UNCCD/UNDP/UNEP (2009) Climate change in the African Drylands: Options and opportunities for adaptation and mitigation.

UNCCD (1994) United Nations Convention to Combat Desertification; Elaboration of an International Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa. U.N. Doc. A/Ac.241/27, 33 I.L.M. 1328, United Nations.

UNEP (2013) Smallholders, Food Security and the Environment.

UNEP (2011) Global Drylands: A UN system-wide response. The Environment Management Group.

Uphoff, N. (2000) Understanding Social Capital: Learning from the Analysis and Experience of Participation, Mansholt Graduate School Seminar.

Vaccaro, I., Smith, E.A. and Aswani, S. (2010) Environmental Social Science: Methods and Research Design. Cambridge University Press.

Van Putten, I. E., Cvitanovic, C., Fulton, E., Lacey, J. and Kelly, R. (2018) The emergence of social licence necessitates reforms in environmental regulation. Ecology and Society 23(3):24.

https://doi.org/10.5751/ES-10397-230324

Vasilis, D., Quinlan, A., Baggio, J.A., Bennett, E., Bodin, O. and Burnsilver. S. (2015) Manage Connectivity. In: Biggs, R., Schluter, M. and Schoon, M.L. (eds) Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems. Cambridge University Press, UK

Walker, B. H. and Salt, D. (2012) Resilience practice: building capacity to absorb disturbance and maintain function. Island Press, Washington, DC.

Walker, B. H. and Salt, D. (2006) Resilience thinking: sustaining ecosystems and people in a changing world. Island Press, Washington, DC.

Walker, B., Carpenter, S., Anderies, J., Abel, N., Cumming, G.S., Janssen, M., Lebel, L., Norberg, J., Peterson, G.D. and Pritchard, R. (2002) Resilience management in social-ecological systems: a working hypothesis for a participatory approach. Conservation Ecology 6(1): 14. [online] URL: http://www.consecol.org/vol6/iss1/art14/

Walker, B.H. (1995) Conserving Biological Diversity through Ecosystem Resilience. *Conservation Biology*, Vol. 9, No.4, 747-752.

Walters, B. B. and Vayda, A. P. (2009) Event Ecology, Causal Historical Analysis, and Human-Environment Research. *Annals of the Association of American Geographers*, 99:3, 534-553.

Walters, P. A. (2004) Local management of mangrove forests in the Philippines: Successful conservation of efficient resource exploitation? *Human Ecology*, 32: 237-246.

Weber, R. (2004) The Rhetoric of Positivism Verses Interpretivism: A Personal View. *MIS Quarterly* Vol. 28, No. 1, pp. 3-12.

Wilkinson, C. (2012) Social-ecological resilience and planning: an interdisciplinary exploration. Stockholm University.

Windle, G. (2011) What is resilience? A review and concept analysis. *Reviews in Clinical Gerontology*, 21, pp. 152-169.

Wolcott, H.F. (2001) Writing Up Qualitative Research. 2nd ed. Sage Publications Inc.

Wong, S. (2007) Exploring 'Unseen' Social Capital in Community Participation: Everyday Lives of Poor Mainland Chinese Migrants in Hong Kong. Amsterdam University Press.

Wong, C. and Iverson, K. (2004) Range of Natural Variability: Applying the concept to forest management in central British Columbia. *BC Journal of Ecosystems Management*, Vol.4,1,1-14.

Woolcock and Narayan (2000) Social capital: implications for development theory, research, and policy. *World Bank Res. Obs* 15, 225-249.

Zhang, A., Moffat, K., Lacey, J., Wang, J., González, R., Uribe, K., Cui, L. and Dai, Y. (2015) Understanding the social licence to operate of mining at the national scale: A comparative study of Australia, China and Chile. *Journal of Cleaner Production*, 108, 1063-1072.

APPENDICES

APPENDIX 1: Survey questionnaire for households

DEPARTMENT OF GEOGRAPHY

FACULTY OF ARTS & SOCIAL SCIENCES, THE OPEN UNIVERSITY

Name of enumerator: _____

Date: _____ *Name of Village:* _____

GPS Location: _____

Introduction: *"Good morning/afternoon/evening, my name is Francis Appiah from the Department of Geography, The Open University in the United Kingdom. I would like to invite you to participate in a research study on the impacts of social and environmental and response dynamics of individuals and communities in the Daffiama Bussies Issa district. This research survey instrument is designed to collect data on how individuals and households respond to both social and environmental change and what underlying principles inform their decisions, and the results will be used for my PhD thesis (entitled* ***"Empirical assessment of the principles of building social-ecological resilience in dryland ecosystems: the case of the Daffiama-Bussie-Issa district of the upper west region of Ghana****) only and responses are strictly confidential. I am particularly interested in your experiences and opinions to enable us better understand the key underlying considerations in responses to change in this village.*

Enumerator: Ask the respondent if they are willing to proceed with the conversation. Tick here to confirm consent:

"Before we proceed with the main interview, I will like to explain a few issues to you to ensure that you understand the interview process and to protect your privacy:

a. It is not compulsory for you to participate in the interview; you can refuse to answer any of the questions posed and withdraw

from the interview at any time.

b. Your participation in the interview is voluntary.

c. Should you decide to withdraw from the interview, you have the right to request that information already provided be removed

and excluded from the study and not used for any other purposes. You can exercise this right at any time and for any reason.

d. Your personal information and other data collected will not be passed on to any person and/ or organisation. Your information

is confidential and will be treated with utmost privacy to protect you from any legal liability that may arise.

e. You are free to contact Dr. Shonil Bhagwat and myself at the Department of Geography, Open University if you

have any queries or concerns. I will provide you with the requisite contact details.

f. The information provided and the ultimate results of the study are to be used for a PhD thesis only.

g. If you are interested in any information about this study and or results of the study, you can contact Dr. Shonil Bhagwat:

shonil.bhagwat@open.ac.uk and myself at the Department of Geography, Open University through the contact details I will

provide.

h. Should you have any questions or concerns about the ethics of the study, you can contact the Department of Geography and the

Human Research Ethics Committee of the Open University through Dr. Duncan Banks: Duncan.banks@open.ac.uk. In the

subject section of your email, please refer to Francis Appiah - PhD Fieldwork in Ghana (HREC/2016/2217/Appiah/1)".

Enumerator: Ask the respondent if they consent to participating in the research by completing the survey. Tick here to confirm consent: ☐

Household # & GPS Coordinates:	Date of Interview:
Name of Interviewer:	Name of Household Head:
Name of Village:	Household Size:
Communal Status: Indigene [ ] 1 / Migrant [ ] 2	Duration of stay in this village:

SECTION A (BASIC HOUSEHOLD CHARACTERISTICS):

[*A household in this context refers to a group of people related or unrelated, having one recognisable head and sharing the same cooking arrangements]*

1. Please record the names, relationship to household head, sex, age, level of education & migration status of each household member:

Name	Relationship to the Household Head **Use codes ****	Sex (M/F)	Age	Level of Education **Use codes** **	Has any of the household members left during the past year (if yes, state the months)	Reason for trip 1- Work 2- Education 3- Visit 4- Other (specify)
Example	**2**	**M**	**35**	**2**	**Sept – Jan**	**1**
1.						
2.						
3.						
4.						
5.						

***Codes: Relation**

1. Household Head Herself/ Himself
2. Wife/ Husband
3. Son/ Daughter
4. Sister/ Brother
5. Mother / Father
6. Grand Father/ Mother
7. Grand Son/ Daughter
8. Non-relative
9. Other relative (specify)

Education

1. Never been to school
2. Primary
3. Middle School/ JHS
4. SHS
5. Vocational School
6. Polytechnic
7. University
8. Other (specify)

SECTION B (Characteristics of landscape units): *Information on ecological interactions, social interactions, plant-animal relationships (grazing/manure) and governance/institutions constituting the social-ecological system is recorded in this section.*

2. Perceptions of human-environment interactions such as forest/savannah – farm interactions

a) Have you heard of environmental services, eg. Wild fruits, medicinal plants?
Yes [ ] 1 No [ ]2

b) Do you make use of any products from the environment?
Yes [ ]1 No [ ]2

c) Do you use the products or sell them?
Yes [ ]1 No [ ]2

d) Do you feel it is important to protect the environment eg. Water bodies, soils, trees?
Yes [ ]1 No [ ]2

e) If yes to d) above, list some activities which in your opinion will help protect and conserve the environment:

g) Please indicate some of the ways you and your household are connected to the environment?

---

h) In your opinion, how dependent is your household on the environment?

Not very much [ ] 1 Quite much [ ] 2 Much [ ] 3 Very much [ ] 4

i) Are there any restrictions to access to environmental resources? Yes [ ]1 No [ ]2 if respondent answers No, go to l)

j) If yes to i) above, what are the restrictions? ---

k) Who determines these restrictions eg. Village chief, family heads, etc? ---

l) How do you influence resource-use dynamics? ---

m) Non-timber forest products (NTFP) and small wood products

	Importance to household	***Use***	***S***
Fire wood			
Kola nuts			
Mushrooms			
Snails			
Medicinal plants			
Wild fruits			
Honey			
Bush meat (Game)			
Spices			
Dawadawa			
Wood for construction (fence, house)			
Wooden/leaf household products			
Shea nuts			

CODE 2M: NTFP Importance | 0-5 scale where 0 = Do not use/not important; 1 = not very important; 2 = quite important; 3 = Important; 4 = Very important; 5 = Essential

3. Water-food nexus and implications

a) In your opinion, has there been any changes to your water system over the last few years? Yes [ ]1 No [ ]2.

What are the causes of the change?

---

b) In your view, to what extent are human activities on the environment responsible for these changes?

Strongly Disagree [ ] 1 Disagree [ ] 2 Agree [ ] 3 Strongly Agree [ ] 4

c) Please list some of these activities you are referring to: ----------

---

---

d) In which ways are food production affecting your water bodies? ----------

---

SECTION C (Non-farming and other economic Activities): *This section records information on the nature and characteristics non-farming production activities such as trading, hunting and exploitation of natural resources within the community.*

4. Non-farming and other economic Activities

a) Are you engaged in other economic activities apart from farming? Yes [ ]1 No [ ]2

b) If Yes to a), please state the activity

How much do you earn (monthly)? GHS 5-50 [ ] GHS 51-100 [ ] GHS 101 and above [ ]

c) Is any household member outside of farming (e.g. galamsey, gov't, NGO)? Yes [ ]1 No [ ]2

d) If Yes to c), how much does this person(s) earn monthly?

---

e) What is the total income (monthly/ annual) of the household from non-agricultural sources?

SECTION D (Agriculture management and production): *Captures information on agricultural management activities.*

5. Farm Productivity

a) What type of farming do you practise, eg, mono-cropping, mixed-farming, agroforestry?

---

b) What is your farm size? ---

c) Has the size of your farm (cultivated area) changed over the last 5 years? Yes [ ]1 No [ ]2

d) If yes to c) above, by how many acres and why. If no, why not? ---

e) What are the crops you cultivate, and why? ---

f) Do you apply organic manure to your plot? Yes [ ]1 No [ ]2. If yes, where is the source? ---

If no, why not? ---

g) Do you apply any fertiliser to your plot? Yes [ ]1 No [ ]2. If yes, where is the source? ---

If no, why not? ---

h) Please complete the table below on estimated annual yield of main crop [insert]:

Year	Estimated Yield
2016	
2015	
2014	
2013	

6. Labour Dynamics

a) What is the source of your farm labour? ----------

b) *Is your farm labour sufficient? Yes [ ]1 No [ ]2.*

If no, how can it be improved? ----------

7. Access to Markets

a) Do you sell produce from you farm? Yes [ ]1 No [ ]2?

b) If yes, what products? ----------

c) What proportion of your other produce do you sell?

All [ ]1 Half [ ]2 Two-thirds [ ]3 None [ ]4 Other [ ]5

d) Where do you sell the other products? ----------

8. Access to Credit Facilities

a) How do you finance your farming activities? ----------

b) Which is the major source of support? ----------

c) Do you (and or any household member) have access to credit? Yes [ ] No [ ]

d) If yes, how much is the credit and for how long? ----------

e) If no to c) above, why not, and what will you have spent credit on and why? Explain:

----

f) What are the sources of credit? ----------

g) What proportion do you invest in farming, and why? ----------

----

9. Perceptions about Long-term Investments and Adoption of New Conservation Technologies

a) Have you heard about Agroforestry, i.e. simultaneously producing crops and trees? Yes [ ] 1 No [ ]2

b) If Yes, what is your understanding of Agroforestry? (Please explain)----------

c) How did you know about it? CREMA [ ]1 NGO [ ]2 Agric. Extension Officer(s) [ ]3 Information Van [ ]4 Other (specify) [ ]5 ----------

d) Do you practise Agroforestry? Yes [ ]1 No [ ] 2

e) If Yes, do you receive any support, and from whom? (Please explain): ----------

(f) Are you willing to practise Agroforestry if supported? Yes [ ] 1No [ ] 2

(g) If No to f), give reasons:

SECTION E (Land tenure dynamics): *This section captures information on land tenure issues regarding land rights, access, laws and customs.*

10. Historical trends & traditions

a) Who has the most influence on land acquisition, use and management decisions in this village eg. Chief, government?

---

b) Who holds the highest title (evidence of ownership) to land in this village? ----------

c) Does existing beliefs (and or) traditions influence your decision of where/how to farm?

Yes [ ]1 No[ ]2

d) If Yes, give reason(s) or evidence for your answer: ----------

11. Ownership, access and security: gender, status

a) What do you perceive land tenure security to be or constitute? ----------

b) Who owns the lands in this village, eg. Chief, family heads. priest? ----------

c) Who has the (ultimate) power to grant out land in this village?

Stool/ Chief [ ]1 Family Head [ ]2 Government [3] Other 4(specify) ----------

d) Do you own the land you are farming on? Yes [ ]1 No [ ]2

f) If yes to f) above, how did you obtain the land? Tick one: Inherited [ ]1 Leased [ ]2 Family land [ ]3 Gift [ ]4 Cash purchase (Individual) [ ]Cash purchase (Stool) [ ]6 Sharecrop- sharecropper [ ] 7 Government [ ]8 Other 9 (specify) [ ]

g) If no to f) above, who owns the land?

Stool/ Chief [ ]1 Government [ ]2 Family [ ]3 Individual [ ] 4 Other (specify) [ ]5 ---------- Don't Know 6 [ ]

h) How did you access the land to farm? (Tick once)

Share cropper [ ]1 Rented Land [ ]2 Caretaker [ ]3 Other (specify) [ ]4 ----------

i) If share cropper, who determines the boundaries?

Share cropper (you) [ ]1 Land owner [ ]2 Chief [ ]3 Surveyor [ ]4 Other (specify) [ ]5 ----------

j) Is the farmland registered? Yes [ ]1 No [ ] 2

k) If yes to j) above, are there any benefits derived from registering your farmland? Yes [ ]1 No [ ]2

l) What is/are the associated benefit(s)? ----------

m) If no to j) above, do you perceive any implications of unregistered farmlands? ----------

n) Do you perceive your ownership/ use of the land as secure? Yes [ ] 1 No [ ]2 and give reasons:

----

o) How do you perceive the status of your right over the land? (Tick once)

Totally secured [ ] 1 Secured [ ] 2 Insecure [ ] 4 Extremely Insecure [ ] 5

Don't know [ ]6

p) Are there any other conditions under which you occupy the land? Yes [ ] 1 No [ ] 2

q) If Yes, what are these other conditions? (Please explain)

---

r) Are these conditions favourable to you? Yes [ ] 1 No [ ] 2

s) If yes, how do these conditions affect your day to day farming decisions? (Please explain)

---

t) Please tick the appropriate box to express the extent of your opinion on how the following statements are applicable to your household or in the village over the next 5 or 10 years:

Statement	Not a problem (1)	Somewhat of a problem (2)	A serious problem (3)
1. Land Conflict in general			
2. The arrival of migrants / other settler farmers			
3. Acquisition of land for non-agricultural purposes			
4. Unable to access to the forest/savannah resources			
5. Inheritance			
6. Former residents returning to claim lands			
7. Accessing land for farming			

SECTION F (Timeline of significant events, changes or disturbances): *This section records information relating to significant events, their nature, causes and effects*

12. Nature, characteristics and processes: physical/socioeconomic/institutional

a) Do you perceive changes in the climate of your area within the last 30 years? Yes [ ]1 No [ ]2

b) Please mention some of the changes you have observed over the years, eg. Heat levels, rainfall patterns, dryness?

---

c) In your opinion, is the climate conditions in drylands continuously changing much rapidly than elsewhere?

Yes [ ]1 No [ ] 2 Please explain your answer: ----------

---

d) For each of the following, indicate how they are changing over the last 10 years in your area (Tick):

Conditions	***Increasing***	***Decreasing***	***No changes***
Rainfall			
Droughts			
Floods			
Temperature			
Harmattan			
Soil fertility			
River systems			

e) Have you or your household experienced any effects from the changes? Yes [ ]1 No [ ]2

f) If yes, please indicate these effects: ----------

---

g) If no, do you know someone or household in your village that has suffered any effects?

Yes [ ]1 No [ ]2

h) Did you anticipate the events leading to the effects? Yes [ ]1 No [ ]2

i) If yes, how did you (or did you not) prepare to respond? Please explain:

---

j) If no, what do you perceive to be the reasons? Please list:

---

k) Are you worried about the changes in the climate in your area? Yes [ ]1 No [ ]2

l) Please describe what you perceive to be the cause (s) of the changes in the climate condition?

---

m) In your opinion, what will be the impact of the changes in the next 5 to 10 years? Please explain:

---

n) Please describe how your household will prepare to respond to the effects in m) above:----------
---

o) In your opinion, how should the community prepare to respond to the changes? Please describe:

SECTION G (Responses and adjustments to change): *This section traces the characteristics of responses, decisions and actions, to the effects of change events*

13. Decision (response) & characteristics of decision making

a) How is the decision on responses to events made in your household? Please explain:

---

b) Who leads the processes of responding to events? ----------
---

c) Are there restrictions on who can initiate and lead the processes? Yes [ ]1 No [ ]2

If yes, please name the restrictions: ----------

---

d) Please describe the nature of the responses?

---

14. Relevant and predominant principles

a) Are there principles (basic idea or rule or values) that determine your responses to disturbances? Yes [ ]1 No [ ]2

b) If yes, mention them: ----------

---

c) Why are those principles relevant? Explain: ----------

---

d) If no to a) above, what do you consider important when responding to changes? Please list your answers:

---

15. Policies, rules, laws, customs & traditions, religion

a) Does existing beliefs (and or) traditions influence your decision of how to respond or prepare to respond to disturbances?

Yes [ ] 1 No [ ] 2

(b) If Yes, give reason(s) or evidence for your answer: ----------
----

----

16. Level of participation, involvement & engagement

a) What is your observation of the level of involvement (participation) of your household in decision-making (activities)?

Not involved [ ] 4 Not much involved [ ] 3 Involved [ ] 2 Much involved [ ]1

b) If household not much involved or not involved in decisions, what reasons can you identify:

----

c) Are there benefits in involving most of the household in decisions? Yes [ ]1 No [ ]2

d) If yes, please list some of the benefits: ----------

----

e) How much are females (Girls & women) engaged in decisions and/or activities?

Not engaged [ ] 4 Not much engaged [ ] 3 Engaged [ ] 2 Much engaged [ ] 1

f) Please explain your answer to e) above: ----------

----

g) In your opinion, will participation improve acceptance and legitimacy of decisions? Yes [ ]1 No [ ]2

h) Does participation promotes understanding and improves perception and attitude? Yes [ ]1 No [ ]2

i) In what ways does participation improves implementation of decisions and actions?

----

j) In what ways does participation fosters the building of trust among household members?

---

k) Would you say high engagement will promote capacity building? Please explain:

---

17. Conflict management

a) Does your household experience conflicts in your activities? Yes [ ]1 No [ ]2

b) If yes, mention the types of common conflicts: ----------

---

c) In your opinion, what are the possible causes of these conflicts? ----------

---

d) Who has the responsibility or authority to resolve these conflicts? ----------

---

e) Please explain how conflicts are resolved when they do arise in your household? ----------

---

f) Describe what happens to conflicts that your household is not able to resolve? ----------

---

g) Please state some of the effects of conflicts on family unity, trust and consensus: ----------

---

SECTION H (Perception of resilience, resilience thinking and adaptive capacity): *Information on perception and understanding of resilience attributes is captured in this section*

18. Familiarity of resilience approach,

a) In your opinion, what is a 'resilient' system (ability to adapt to changing conditions and prepare for the future)?

Please name some of its attributes:

----

b) Please mention some principles that can help to improve resilience of a system? ----------

----

c) Describe how the principles can work to improve resilience? Please give examples: ----------

----

d) What issues can affect these principles in the process of building resilience? ----------

----

e) Please tick the principles below that you are familiar with and indicate how you put into use:

Principle	***Familiar (Tick)***	***Application/examples***
Diversity & redundancy (Range of different elements)		
Connectivity (Way of interactions among variables)		
Slow variables & feedbacks (Variables with slow rate of change)		
Complex Adaptive System thinking (System of interconnected components)		
Learning (Process of modifying existing or acquiring new knowledge, skills, values)		
Participation (Active engagement of relevant stakeholders)		
Polycentric governance system (Multiple nested governing bodies)		

f) In your opinion, is the 'capacity to be resilient' and 'resilience of a system' similar?

Yes [ ]1 No [ ]2

Please explain your answer: ----------

g) Which of the two concepts in f) above would indicate the level of resilience of a system, and which will you prefer to work with?

Please explain why ----------

h) Do you agree that system's adaptive capacity largely determines the level of its resilience?

Strongly Disagree [ ] 1 Disagree [ ] 2 Agree [ ] 3 Strongly Agree [ ] 4 Don't Know [ ]5

i) Please explain your answer to h) above: ----------

j) Please explain how adaptive capacity works to build resilience?

k) In your opinion, why should people prioritize the building of resilience in drylands? Explain

l) Describe how resilience can be improved in drylands? ----------

m) Do you agree that resilience is not always desirable in every instance?

Strongly Disagree [ ] 4 Disagree [ ] 3 Agree [ ] 2 Strongly Agree [ ] 1

n) Please explain your answer to m) above: ----------

THANK YOU

APPENDIX 2: Guiding questions for focus group discussion and interviews

A) FGD Questions:

1. Please identify and discuss livelihood challenges your community faces?

2. Discuss specific response(s) people adopt, and why are these important?

3. What can the society do to be more resilient against future threats?

B) Individual in-depth interview Questions (Used the snowballing technique to identify 5 respondents):

1. Please describe a major event (environmental, social, and political) that has had significant impact on your community in the last 5-10 years?

2. Explain specific effects of the event identified in Q1 on the people's livelihood?

3. What specific responses did people adopt to cope with the effects, and would you say these responses were effective or not?

4. What principles or basic ideas guided their responses?

5. Are the present conditions sufficient to overcome similar challenges in the future?

6. If not sufficient enough, how can the present conditions be improved to prepare for the future occurrences?

C) Interview with the Tindana (land owners):

1. Please describe the history of how your people came to own the land, and how is succession passed on?

2. Describe your role in access to land and other natural resources on the land?

3. Explain the nature and process of acquiring land, and how flexible it is?

4. Discuss land tenure security and how land issues are resolved, and how land security can be improved?

APPENDIX 3: Consent form for persons participating in a research project

Department of Geography

Empirical assessment of the role of adaptive capacity in building social-ecological resilience in a dryland ecosystem: the case of the Nadowli-Kaleo district in the upper west region of Ghana

Name of participant:

Name of principal investigator(s): Francis Kwame Appiah

---

1. I consent to participate in this project, the details of which have been explained to me, and I have been provided with a written statement in plain language to keep.
2. I understand that my participation will involve ethnographic research methods and I agree that the researcher may use the results as described in the plain language statement.

3. I acknowledge that:

   a. the possible effects of participating in this research have been explained to my satisfaction;

   b. I have been informed that I am free to withdraw from the project without explanation or prejudice and to request the destruction of any data that have been gathered from me until it is anonymized at the point of transcription point on INSERT DATE, After this point data will have been processed and it will not be possible to withdraw any unprocessed data I have provided;

   c. the project is for the purpose of research;

   d. I have been informed that the confidentiality of the information I provide will be safeguarded subject to any legal requirements;

   e. I have been informed that with my consent the data generated will be stored STATE LOCATION and will be destroyed after five years;

   f. If necessary any data from me will be referred to by a pseudonym in any publications arising from the research;

   g. I have been informed that a summary copy of the research findings will be forwarded to me, should I request this.

I consent to this **RESEARCH METHOD** being audio-taped/video-recorded □ **yes** □ **no** (please tick)

I wish to receive a copy of the summary project report on research findings □ **yes** □ **no** (please tick)

Participant signature: Date:

Francis Kwame Appiah, Department of Geography, Faculty of Social Sciences, The Open University, Walton Hall, Milton Keynes, MK7 6AA, United Kingdom.

APPENDIX 4: Ethical Approval: Human Research Ethics Committee

From Duncan Banks, Deputy Chair
The Open University Human Research Ethics Committee
Email duncan.banks@open.ac.uk
Extension (6) 59198
To Francis Kwame Appiah, Department of Geography, Faculty of Social Sciences
Project title Empirical assessment of the role of adaptive capacity in building social-ecological resilience in a dryland ecosystem: the case of the Nadowli-Kaleo district in the upper west region of Ghana. HREC ref HREC/2016/2217/Appiah/1
AMS ref

Memorandum

Date application submitted: 11/04/16
Date of HREC response : 15/04/16
This memorandum is to confirm that the research protocol for the above-named research project, as submitted to the OU HREC for ethics review, has been given a favourable opinion bythe HREC Review Panel.
Please note the following:
1. You are responsible for notifying the HREC immediately of any information received by you, or of which you become aware which would cast doubt on, or alter, any information contained in the original application, or a later amendment which would raise questions about the safety and/or continued conduct of the research.

2. It is essential that any proposed amendments to the research are sent to the HREC for review, so they can be recorded and a favourable opinion given prior to any changes being implemented (except only in cases of emergency when the welfare of the participant or researcher is or may be effected).

3. You are authorised to present this memorandum to outside bodies such as NHS Research Ethics Committees in support of any application for future research clearance. Also, where there is an external ethics review, a copy of the application and outcome should be sent to the HREC.

4. OU research ethics review procedures are fully compliant with the majority of grant awarding bodies and where they exist, their frameworks for research ethics.

5. At the conclusion of your project, by the date you have stated in your application, you are required to provide the Committee with a final report to reflect how the project has progressed, and importantly whether any ethics issues arose and how they were dealt with. A copy of the final report template can be found on the research ethics website - http://www.open.ac.uk/research/ethics/human-research/human-research-ethics-full-review-process-and-proforma#final_report

Best regards,
Dr Duncan Banks, Deputy Chair
The Open

APPENDIX 5: Research introductory letter

TO WHOM IT MAY CONCERN

Dear Sir/ Madam,

LETTER OF INTRODUCTION: MR. FRANCIS APPIAH KWAME

I am writing this letter to introduce and support **Mr. Francis Appiah**, who is a PhD student under my direct supervision at the Department of Geography, The Open University.

As part of his PhD research (**focusing on understanding how resource-poor communities respond to the impacts of deleterious social and environmental events**), Francis is currently undertaking a field work data collection visit in Ghana within the Daffiama-Bussie-Issa District of the Upper West Region and will require institutional level data and support, as well as social, environmental and cultural data.

I therefore kindly request that you give him all the necessary assistance he may require to obtain relevant data for his PhD research.

Many thanks in advance for your kind cooperation.

Sincerely,

Dr. Shonil Bhagwat

Department of Geography, Faculty of Social sciences

The Open University

Walton Hall, Milton Keynes

MK7 6AA.

Email: shonil.bhagwat@open.ac.uk

Tel: +44(0) 1908 654488